WATER & SEWAGE WORKS

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ANN ARBOR, MICH.
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WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

Chicago's South Side Filtration Plant
See "Quest for Potable Water", page 184

Research Studies on Recovery of a Polluted River

How to Select and Care for Sewage Sludge Filter Blankets

MAY 1955

WATER... guardian of the city

From earliest times, mankind has recognized water as the guardian of its safety. The medieval castle relied on its water-filled moat to discourage attack. Today, water is still man's first line of defense against disease and fire.

The vital pipelines which form this first line of defense are the prime concern of farsighted water works officials. More and more of them are turning to LOCK JOINT CONCRETE PRESSURE PIPE on the basis of time-tested performance. The danger of crippling the city's water supply and sanitary facilities through burst or ruptured pipe does not exist in Lock Joint pipelines. The pipe's initial high carrying capacity is permanent, assuring ample water and pressure to combat the hazards of fire.

With Lock Joint you can benefit from these advantages in a virtually ageless pipeline which will require very little, if any, maintenance.

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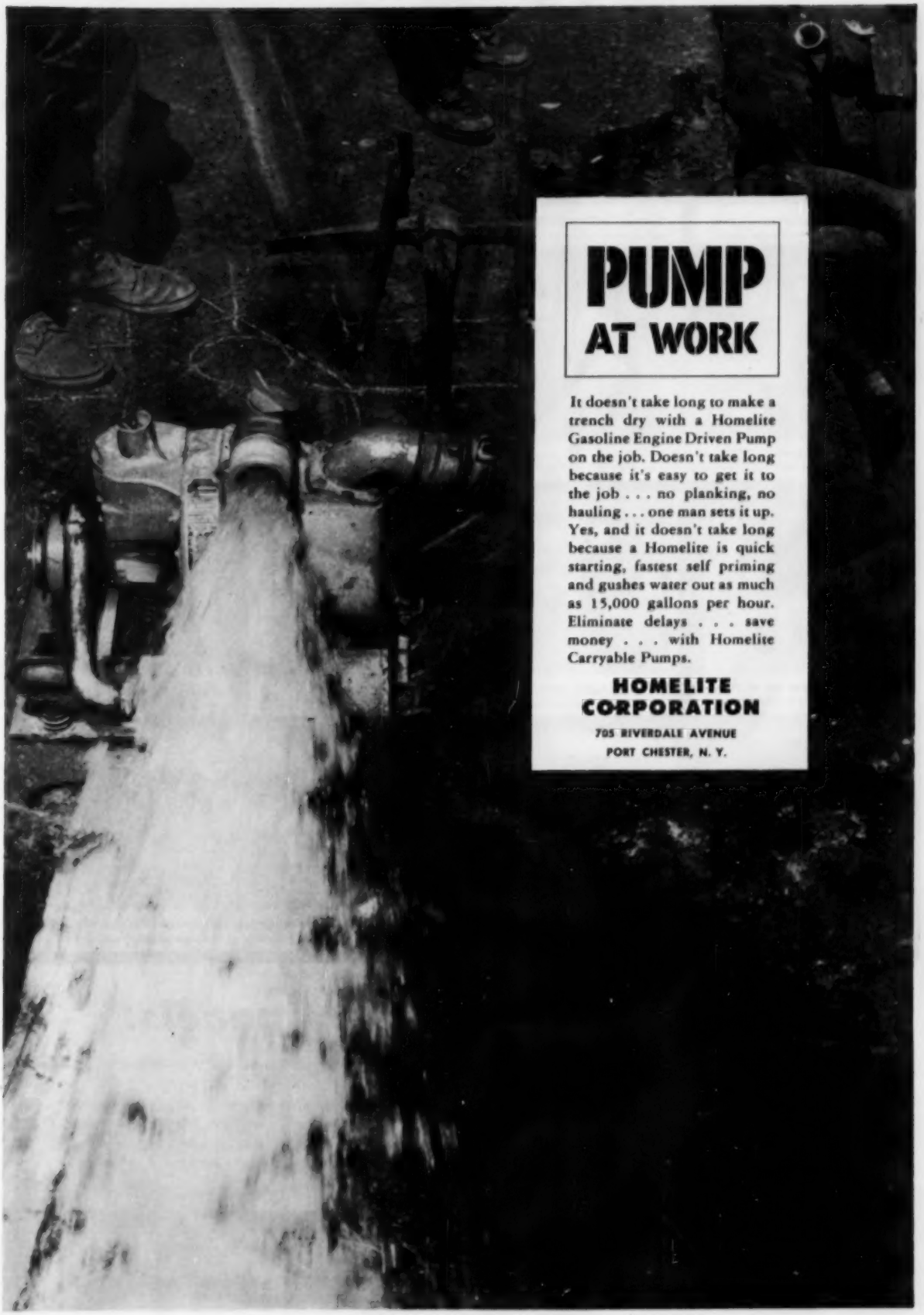
East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous



PUMP AT WORK

It doesn't take long to make a trench dry with a Homelite Gasoline Engine Driven Pump on the job. Doesn't take long because it's easy to get it to the job . . . no planking, no hauling . . . one man sets it up. Yes, and it doesn't take long because a Homelite is quick starting, fastest self priming and gushes water out as much as 15,000 gallons per hour. Eliminate delays . . . save money . . . with Homelite Carryable Pumps.

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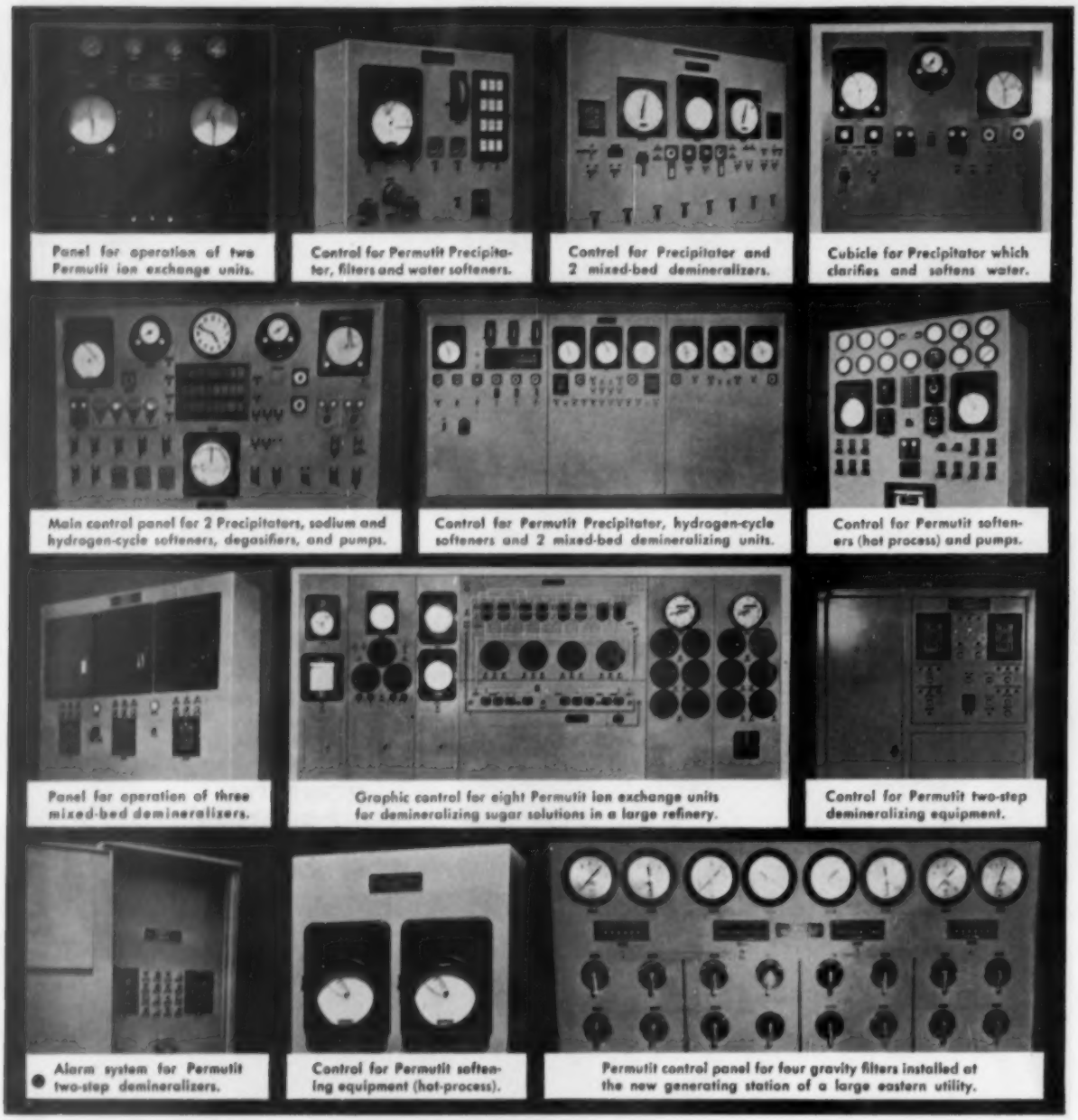

Panel for operation of two Permutit ion exchange units.

Control for Permutit Precipitator, filters and water softeners.

Control for Precipitator and 2 mixed-bed demineralizers.

Cubicle for Precipitator which clarifies and softens water.

Main control panel for 2 Precipitators, sodium and hydrogen-cycle softeners, degasifiers, and pumps.

Control for Permutit Precipitator, hydrogen-cycle softeners and 2 mixed-bed demineralizing units.

Control for Permutit softeners (hot process) and pumps.

Panel for operation of three mixed-bed demineralizers.

Graphic control for eight Permutit ion exchange units for demineralizing sugar solutions in a large refinery.

Control for Permutit two-step demineralizing equipment.

Alarm system for Permutit two-step demineralizers.

Control for Permutit softening equipment (hot-process).

Permutit control panel for four gravity filters installed at the new generating station of a large eastern utility.

Why we make our own panels:

Life might be simpler if we "farmed out" our control cubicles and instrument panels . . . but we like to build *every* major component of a PERMUTIT water-conditioning or ion exchange system . . . so that we know it will do its specific job properly.

That's why these panels . . . and the hundreds of others in power plants, chemical process plants, manufacturing plants and municipal water works . . . are designed by Permutit engineers and assembled, wired and piped in Permutit factories.

That's why we design and build our own special parts such as multiport valves, strainer systems and chemical feeders. That's why we make our own ion exchange resins.

As a result, we talk in terms of over-all results. And you get *complete* service from *one* source.

For further information, write to: The Permutit Company, Dept. W-5, 330 West 42nd St., New York 36, New York.

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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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(Member—Audit Bureau of Circulation and Associated Business Publications, Inc.)

In Cleveland's Sewage Disposal Improvement Program . . . WROUGHT IRON PIPE stands guard against corrosive attack

There's plenty of evidence in Cleveland's Southerly Sewage Disposal Plant improvement program to show that the City's planners put a great deal of emphasis on economy of operation. One outstanding example is the extensive use of wrought iron pipe. More than 115 tons of this corrosion-resistant material was installed in the following services:

- Sludge digestion and elutrition tank piping
- Cold water lines—1" to 2½"
- Downspouts and leaders
- All heating piping
- Handrailings
- Blower lube oil piping
- Perforated pipe diffusers
- Expansion tank piping
- Air piping
- Air intake piping
- Diesel oil piping
- Exhaust gas piping

The entire program is supervised by City of Cleveland's Director of Public Utilities, Emil J. Crown, and is under the direction of Commissioner of Engineering, G. W. Hamlin, and Commissioner of Division of Sewage Disposal, G. E. Flowers.

The corrosion hazard in each of these services is well recognized. Many engineers, from all sections of the country, can certify how effective wrought iron pipe is in combating the condition, and providing long, economical life. Our bulletin, *Wrought Iron for Sewage Treatment and Disposal Installations*, discusses these, and other services, and documents wrought iron pipe's outstanding performance in each.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Dept.: New York, N.Y. *Available throughout the world.*

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A large filtration plant Superintendent has this to say:

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Shenango Valley Water Company converts six filters to ALOXITE® underdrains

The Shenango Valley Water Company started operation in 1884 with five miles of mains serving 600 customers and 80 fire hydrants. Today, its 140 miles of mains deliver an average of 7 MGD to 14,000 homes, businesses and institutions in the Sharon-Shenango Valley region of Pennsylvania.

The company's eight filters have a capacity of 8 MGD. Its first ALOXITE aluminum oxide porous underdrain was installed in 1952. Since then, five more filters have been similarly modernized — the sixth set of ALOXITE plates is about to go into service.

This continuing program of filter modernization speaks well for the operating advantages provided by filters built with ALOXITE underdrains: elimination of upset beds . . . complete backwashing . . . freedom from mudballs . . . minimum loss of head.

It is easy to see why the Shenango Valley Water Company has been able to keep so well abreast of the growing water needs of the area it has served so long. The company's management and engineering staff deserve much credit for their progressive policy.

This informative 56-page booklet covers porous media for all fields of filtration and diffusion. Write us for your free copy today.

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Registered Trade Mark

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The Carborundum Company, Perth Amboy, N. J.

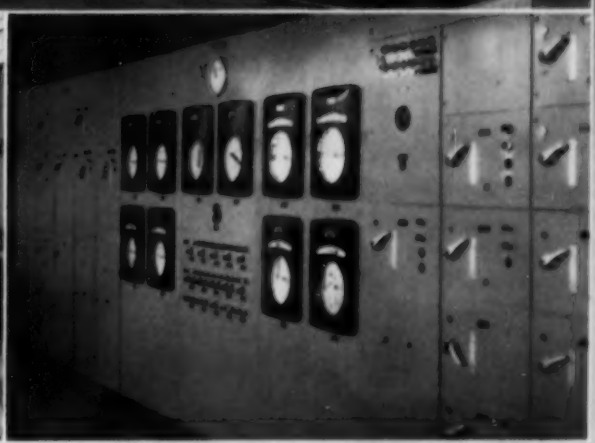
WILMINGTON, DEL.

Porter Rapid Sand Filter Plant

(COMPLETED IN 1953)

METCALF & EDDY
Engineers
Boston, Mass.

View of the filter gallery showing Builders Filter Operating Tables with Loss-of-Head and Rate-of-Flow Gauges.



Main Operating Panel showing Builders Chronoflo Receivers for metering principal in-plant flows.

Residents of the City of Wilmington can point with pride to this 16 to 24 million gallon per day filter plant. The trim modern lines of its exterior and the orderliness of its galleries are indicative of the plant's high functional efficiency. Design and engineering were carried out by Metcalf & Eddy in cooperation with W. Compton Wills, Manager and Chief Engineer of the Wilmington Water Department.

The plant includes Builders Meters and Controls, installed by the mechanical contractors, Riggs, Distler & Co., Inc. of Philadelphia, sub-contractors to Baton Construction Company — of vital importance in maintaining efficient plant operation the year 'round. For complete information on Builders Water Works Equipment installed in the Porter Rapid Sand Filter Plant, write Builders-Providence, Inc., Providence, Rhode Island.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

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with PITT CHEM® Tar Base Coatings

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You can sum it up this way: ***No other material does such a complete job of protection at so little cost.***

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WE MAY "FLY LIKE THE BIRDS"

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But in that Jules Verne-like world of tomorrow you'll find one familiar note: water and gas will still be carried by the dependable cast iron pipe laid today.

Throughout the nation, records show that over sixty American cities still use cast iron water and gas mains laid more than a century ago. No pipe can match cast iron's demonstrated longevity. And today, U. S. Pipe, centrifugally cast, is even stronger, tougher, more durable.

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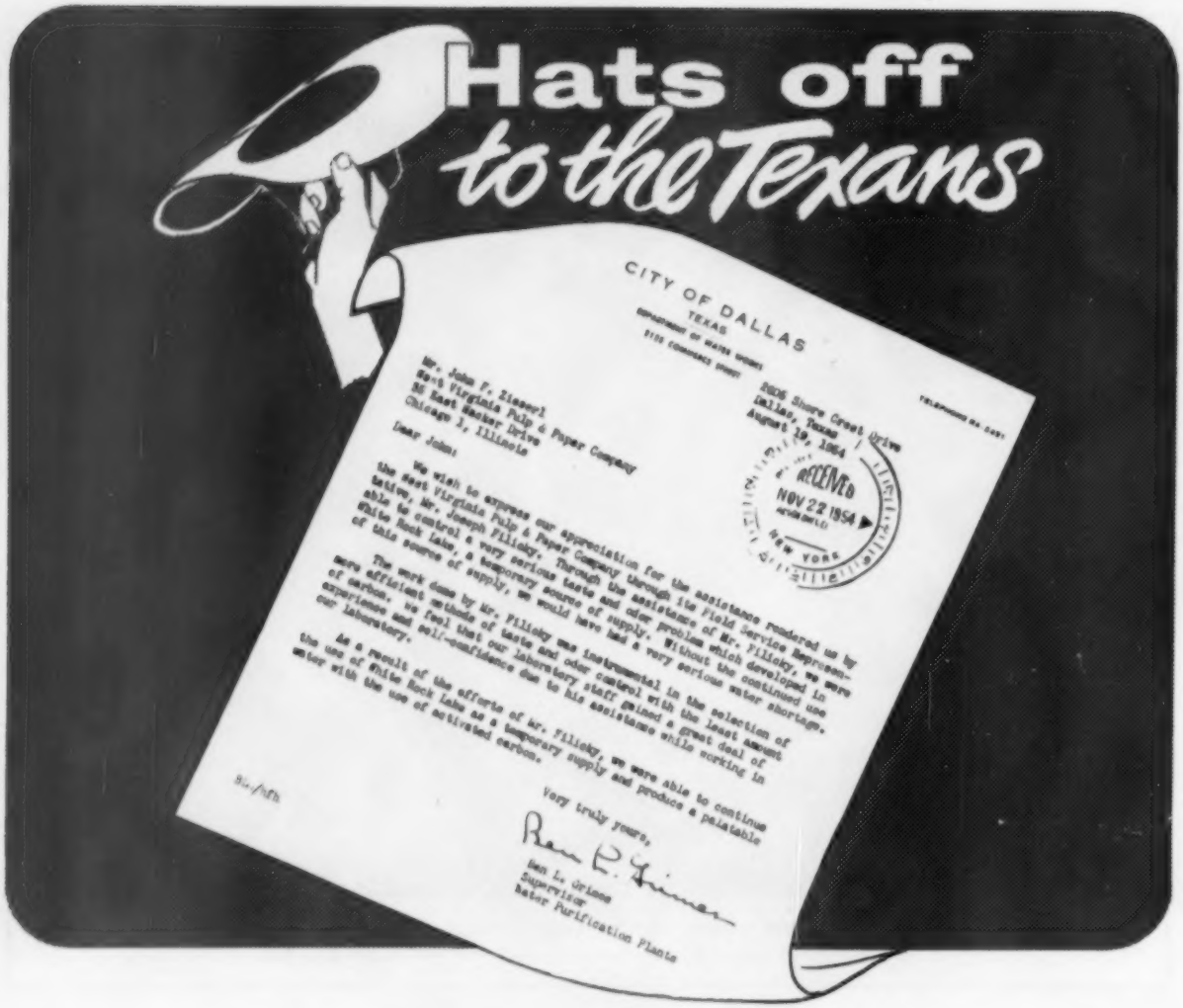
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to the Texans
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TEXAS
August 19, 1954
RECEIVED
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West Virginia Pulp & Paper Company
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Dear John:
We wish to express our appreciation for the assistance rendered us by the West Virginia Pulp & Paper Company through its Field Service Representative, Mr. Joseph Filisky. Through the assistance of Mr. Filisky, we were able to control a very serious taste and odor problem which developed in our laboratory.
The work done by Mr. Filisky was instrumental in the selection of more efficient methods of taste and odor control with the least amount of carbon. We feel that our laboratory staff gained a great deal of experience and self-confidence due to his assistance while working in our laboratory.
As a result of the efforts of Mr. Filisky, we were able to continue the use of White Rock Lake as a temporary supply and produce a palatable water with the use of activated carbon.
Very truly yours,
Ben L. Grimes
Supervisor
Water Purification Plants

In addition to offering Aqua Nuchar activated carbon, Industrial is vitally interested in performing other services to assist in the intelligent use of its product. One phase of this activity is to provide technical service to you in your own plant.

Without obligation, Industrial's technical staff will be glad

a) to make a complete taste and odor survey of your plant,

b) to assist operators in the techniques of running Threshold Odor Tests,

c) to advise as to the most efficient methods of producing palatable water,

d) to check the influences of other chemicals used in your water treatment and recommend how Aqua Nuchar activated carbon may best be used in conjunction with them.

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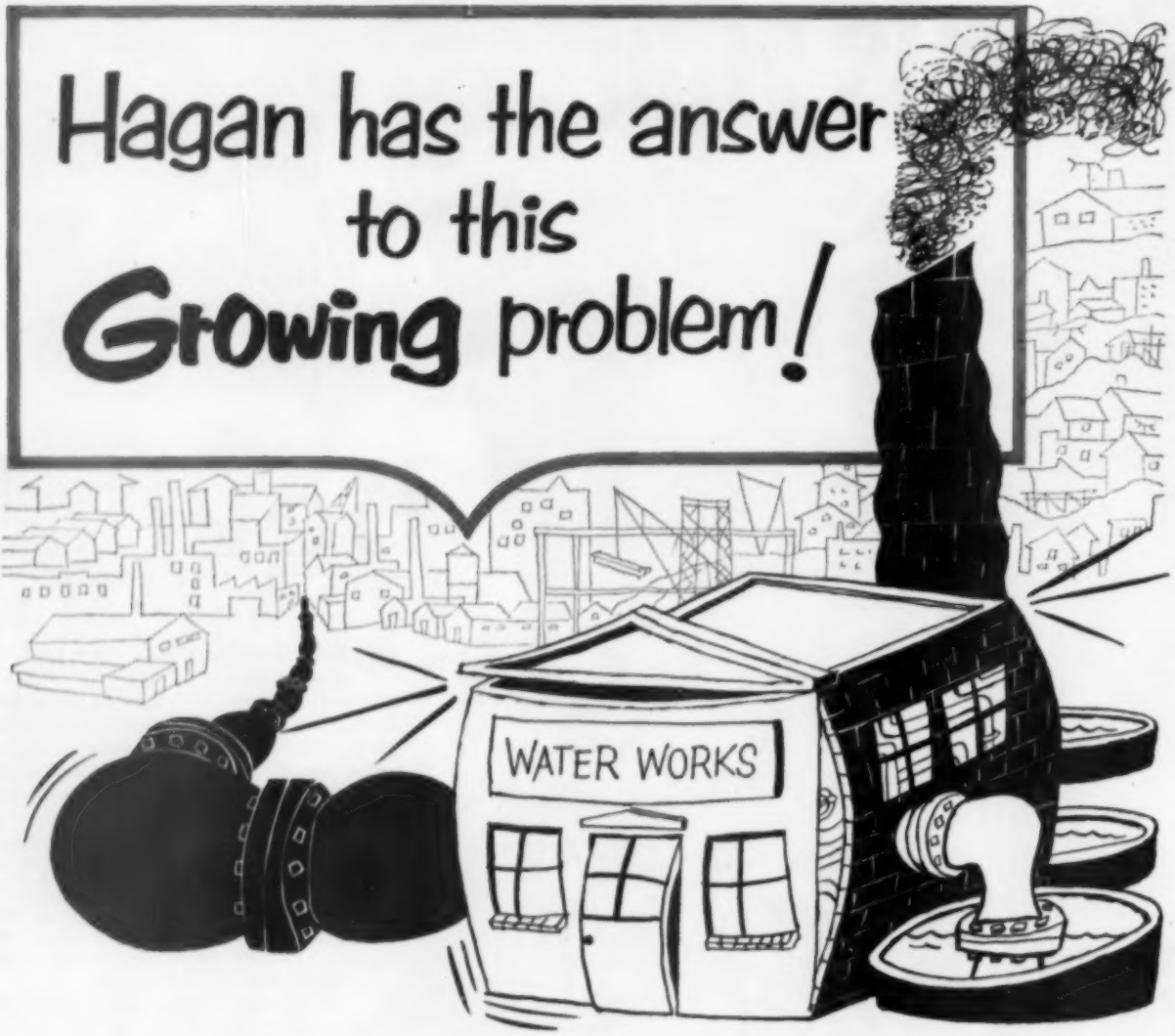
Badger Water Meters

Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measuring the water of the world for 50 years"

Hagan has the answer to this **Growing** problem!



If rapidly growing demand has your water works "bursting at the seams" . . . then Hagan Automatic Controls and Ring Balance Meters can help. Of course, we can't expand your mains or increase your pumping capacity but we can improve the efficiency of your purification plant.

Completely automatic and metered filtration, controlled and recorded at a central panel, will free both operators and supervisors for other duties and provide dependable, efficient, economical operation. Rate of flow, loss of head, basin level, chemical feed and automatic backwash control are all handled by equipment manufactured by Hagan Corporation.

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When you're pumping sewage under pressure, you can rely on Bethlehem Tar-Enameled Steel Pipe. It stands up under the toughest conditions —with plenty to spare. The chart below shows one reason why.

Here are some more reasons: Bethlehem Tar-Enameled Steel Pipe has the *resilience* to withstand the pounding of heavy traffic; it has the great *beam strength* to span washouts; and it has a smooth *coal-tar enamel lining* that resists corrosion and ensures high flow coefficients, year after year. Whether you use mechanical couplings, welds or rivets, you get a tight, leak-proof line. And, remember, we are equipped to produce lined, coated and wrapped pipe up to 96 in. ID at our Steelton, Pa., pipe shop.

That's only part of the story about Bethlehem Tar-Enameled Steel Pipe. For complete information, may we suggest that you call the nearest Bethlehem sales office.

THEORETICAL INTERNAL PRESSURES OF STEEL PIPE

	1/4 in.			5/16 in.			3/8 in.			7/16 in.			1/2 in.		
DIAM	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI
18	49	445	1390	61	555	1735	73	665	2080	85	775	2430	96	890	2780
20	54	400	1250	68	500	1560	81	600	1875	94	700	2180	107	800	2500
22	63	365	1135	78	465	1420	93	550	1700	109	640	1985	124	730	2270
24	69	335	1040	86	420	1300	102	505	1560	119	585	1820	136	665	2080
30	86	270	835	108	340	1040	129	405	1250	150	475	1455	170	535	1670
36	106	225	695	130	280	870	155	340	1040	181	395	1210	206	445	1390
42	119	195	595	148	240	745	177	285	890	206	335	1040	234	380	1190
48	137	170	520	171	210	650	203	250	780	236	290	910	268	330	1040
54				192	190	580	230	225	695	267	260	810	303	295	925
60				214	170	525	255	200	625	296	235	730	336	265	835
72							309	170	520	359	195	605	408	220	695
84							357	145	450	412	170	520	470	190	595
96	The recommended minimum wall thickness is approximately the pipe diameter divided by 165. Pipe having this diameter-thickness ratio, when backfilled and properly tamped, will withstand any depth of cover. For buried pipe, the recommended minimum thicknesses are shown immediately above heavy black line.									470	145	455	539	165	520
108													*611	150	465
120													*669	135	415

$$P = \frac{t \times T_s}{r}$$

P = internal pressure, psi
t = thickness, in.
T_s = allowable unit stress = 60% x 27,000 (yield point) = 16,000 psi
r = radius of pipe, in.

Based on use of ASTM A-283, Grade B Steel, 50,000 psi min. ultimate tensile strength.
*Under certain conditions stiffeners may be required to reduce deflections.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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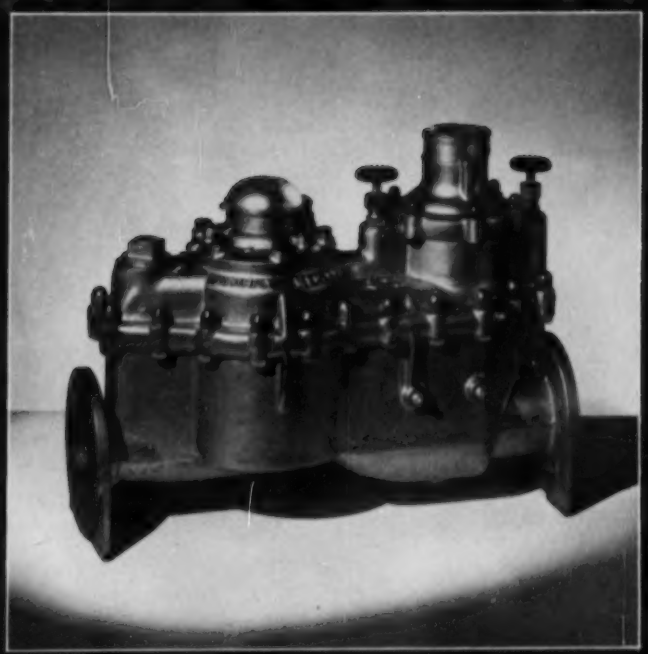

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Roll-On Joint Pipe For Permanence!

The ROLL-ON JOINT pioneered by the American Cast Iron Pipe Company and accepted as a standardized joint of the cast iron pressure pipe industry, is now available in both large and small diameter pipe. Roll-On joint pipe was introduced sixteen years ago.

Roll-On joint pipe is cast centrifugally by the Mono-Cast process in sizes 2" through 48". Standard joint materials, including rubber ring, jute and bituminous joint compound are furnished with the pipe. Roll-On joint pipe is easily and quickly assembled by unskilled labor.

This type of pipe is offered as an alternate for standard Bell and Spigot pipe. Having a positive rubber-packed bottle-tight joint, Roll-On is lower in first cost than other types of joints. It is included in the new Federal Specification WW-P-00421 as Joint Type II.

The above illustration shows 48" AMERICAN Roll-On Joint pipe being used in the construction of a 7-mile-long water supply line in Texas. Depending upon local conditions, the contractor laid from 500 feet up to 1,000 feet per day. The final tests on the line showed the Roll-On Joints to be bottle-tight.

Users of this type of cast iron pipe are enthusiastic about it.

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Booths 54 and 55 A. W. W. A. Conference

AMERICAN

1905 - GOLDEN ANNIVERSARY - 1955

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A GENERAL FILTER WATER TREATMENT PLANT WILL FIT YOUR NEEDS LIKE A *Prescription!*

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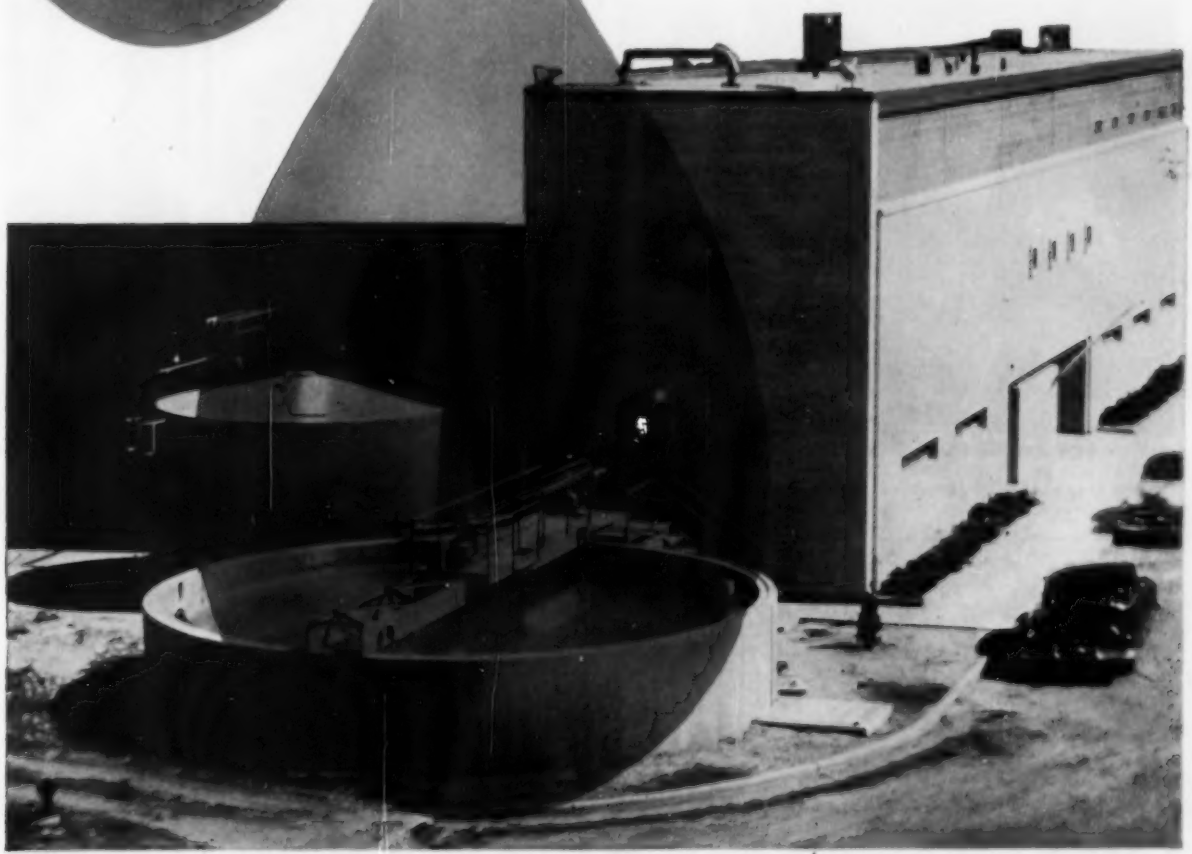
RESINOUS ZEOLITE
plus the
EXPERIENCE • KNOW-HOW
FACILITIES
TO SOLVE *your*
WATER TREATMENT
PROBLEM

That's right! General Filter actually *prescribes* a water treatment plant to fit the individual needs and requirements of each industry or municipality . . . designs, engineers and constructs it to assure an adequate supply of *pure* water . . . to provide dependable, economical, trouble-free operation over the years.

That's why more and more industries and municipalities are installing General Filter water treatment plants. They *know* they can depend on General Filter to solve their problem the *right* way. No job is too big or too small. General Filter's field-trained water specialists will *prescribe* a plant . . . its experienced engineers will *design* it and its skilled construction engineers will *build* it to fit your needs *exactly*.



Find out how General Filter solves Water Treatment problems for Industries and Municipalities . . . Find out how General Filter can solve yours.

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AMES, IOWA

"yours for better water"

STEEL PIPE solves headroom problem as Newark modernizes vital water control station

Back in 1800, the community of Newark, New Jersey, used a water supply system of hollow logs. Today, over 50 miles of huge steel primary feed lines rush upstate water to more than half a million people.

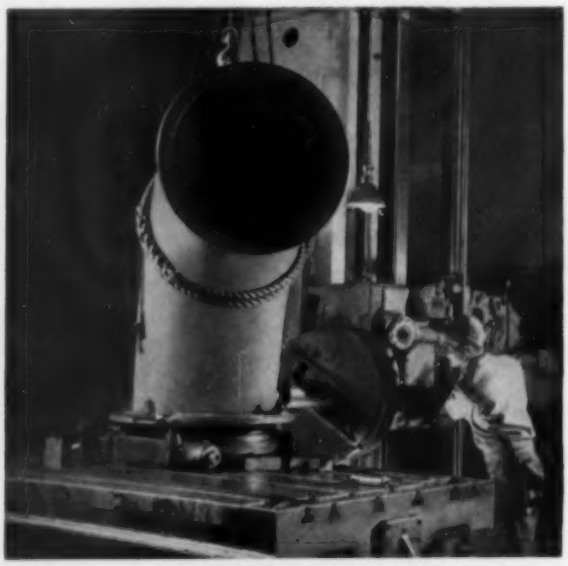
Focal point of this system, which includes nine major reservoirs and over 150 square miles of watershed, is the Bloomfield Avenue Tower, terminal for five of the six main feeder lines. Modernization recently called for replacement at the tower of 35 small double-gated valves with 8 new cone-type valves and requisite piping to handle the system's high pressure flow.

Low headroom and critical location made pipe selection particularly vital. The problem was solved with Alco Electric Welded Steel Pipe—1650 ft of 48-in., 450 ft of 36-in. and 30 ft of 60-in. pipe. Through it will surge over 85 million gallons of water per day.

Furnished in diameters from 20 to 120 in. and lengths to 40 ft, Alco Electric Welded Steel Pipe is specified the country over for its engineered strength, efficiency, economy and long life.

So whether your installation is large or small, special or standard, have a talk with your Alco Products sales representative. He will give you complete technical data—plus expert help with your own special problems.

CITY OF NEWARK uses strong, efficient Alco Electric Welded Steel Pipe in 36, 48 and 60-in. diameters and special sections (shown above) at vital Bloomfield Tower control station.



COMPLETE, modern facilities and many years of experience enable Alco to fabricate top quality low cost pipe for almost any installation, standard or special.

Remember these Key features of Alco Steel Pipe

STRONG: Unaffected by vibration. Maximum resistance to shock, and to overloading due to earth movement and washouts.

EFFICIENT: Positively watertight. Minimum number of field joints. Smooth surfaces for highest rate of flow.

ECONOMICAL: Low first cost. Long lengths, light weight for easy installation.

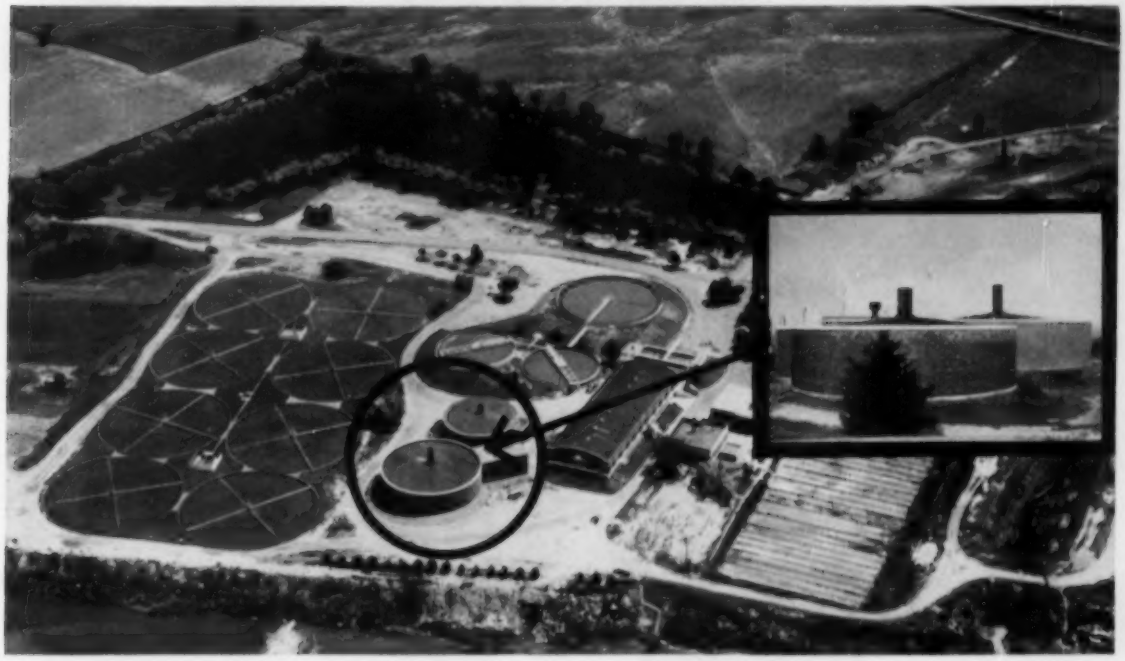
DURABLE: Life in water supply installations estimated conservatively at 75 to 100 years.

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
DUNKIRK, N. Y.

Sales Offices: New York, Chicago, Dunkirk, Los Angeles
Kansas City, Houston, Tulsa and Beaumont.

Circled area shows 2 PFT Floating Covers—long building to the right contains 5 rectangular PFT Floating Covers



Lincoln, Nebraska continues modernizing

WITH PFT "CONTROLLED DIGESTION"

This unusual trickling filter plant at Lancaster Sanitary District #1 in Lincoln has undergone 3 major expansions in 18 years. It provides an excellent example of building for modern treatment on the base of full utilization of existing structures.

In its 1937 expansion, the District converted 5 small rectangular Imhoff Tanks into digesters, installing a *PFT Floating Cover* on each. Floating Covers were chosen for their positive scum submergence, flexibility of operation and safe utilization of gas.

Another digester was added in 1941 — a 65′ circular digester, again equipped with PFT Floating Cover along with PFT Gas Safety Equipment.

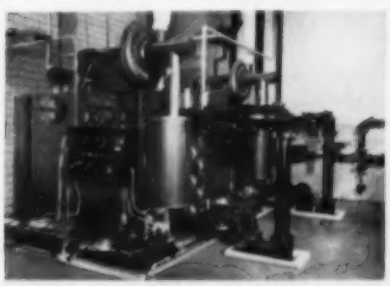
Lincoln's latest expansion came in 1953 when an 85′ diameter digester with PFT Floating Cover was installed.

In addition, a *PFT Heater & Heat Exchanger* unit was added (750,000 B.T.U. per hr.) for efficient and economical sludge heating. Fired by the sludge gas itself, the heater consumes the absolute minimum of purchased fuel.

A well planned gas safety system was also installed in 1955, including the following PFT equipment: Waste Gas Burners; Flame Trap; Pressure Relief with Flame Trap; Drip Taps; Auxiliary Flame Cell; Gas Check Valves; Gas Pressure Gauge.

Congratulations to Lincoln on making excellent use of older equipment in building a highly modern, efficient plant!

Design of plant by / *Black & Veatch, Consulting Engineers, Kansas City, Mo.*



PFT #750 Heater & Heat Exchanger — Gas-fired

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

LOW COST

"CENTURY"® PIPE

is made of asbestos fiber and portland cement—two practically indestructible materials. Its extreme durability means extra long life. Highly resistant to soil corrosion, immune to tuberculation and electrolysis, it assures maintenance-free service and consistently lower pumping costs.

More and more cost and tax-conscious communities are turning to "CENTURY" Pipe. We will gladly furnish information about its advantages. Write today for booklet "Mains Without Maintenance."

QUALITIES THAT MAKE "CENTURY" PIPE ECONOMICAL, TROUBLE-FREE, LONG-LIVED

1. NON-TUBERCULATING
2. NON-CORROSIVE
3. EXCEPTIONALLY STRONG
4. DURABLE
5. IMMUNE TO ELECTROLYSIS
6. TIGHT JOINTS
7. SMOOTH BORE
8. EASILY, QUICKLY LAID
9. LIGHT WEIGHT
10. LOW COST

"Century" Pipe meets the A.W.W.A., A.S.T.M. and Federal Specifications for asbestos-cement pressure pipe.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

K&M Cast in asbestos®

"Little Boomer": Oliver OC-3 crawler and hydraulic boom do real big job

Nicknamed the "Little Boomer", this Oliver OC-3 with hydraulic sideboom is proving highly successful on all types of light pipelaying operations.

The OC-3 is a tough, compact crawler that packs a big 21.85 drawbar h.p. Its size and weight handle a surprising amount of heavy-duty work, yet it is easily and inexpensively transported from job to job on a light trailer or truck.

Differential steering on the OC-3 keeps power on both tracks, even on turns. You can edge up to the ditch smoothly without jerking. Crawler traction lets you work in all conditions. And the OC-3 handles as easily as a car and maneuvers quickly in tight quarters.

Side-boom action is hydraulically controlled so you can lift or lower with accurate control. Only two controls operate the boom. Even an inexperienced operator becomes an expert in a short time. Investigate the "Little Boomer" for your work. See your Oliver Industrial Distributor for complete details.

Power on both tracks at all times plus extra-high clearance enable the OC-3 crawler to work in hard-to-get-at places. Note street pads on tracks that prevent damage to roads or turf. Hydraulic sideboom manufactured by Midwestern Engine & Equipment Co., Inc.

THE OLIVER CORPORATION
400 W. Madison Street, Chicago 6, Illinois

OLIVER

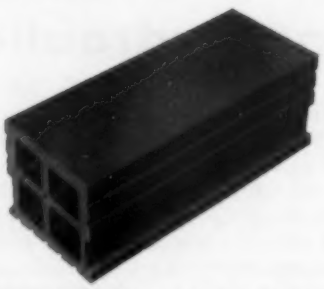
A complete line of industrial wheel and crawler tractors

Ten more "top" filter plants select LEOPOLD Bottoms

Including these ten new major installations — six of which are still under construction — Leopold glazed tile filter bottoms are successfully serving well over 300 plants (with a daily capacity of 1¾ billion gallons). Every year Leopold bottoms are gaining in popularity — and for good reasons, too.

In this design, laterals and distributing blocks are combined in one permanent unit that insures equal distribution and uniform filtration. The individual blocks are made of de-aired fire clay, vitrified and salt glazed. They resist corrosion, are not subject to tuberculation, won't absorb any detrimental amount of water, are impervious to acids and alkalis, and will last indefinitely.

If you're looking for a practical, economical solution to your under-drain problems, consider the advantages offered by Leopold.



Each individual distribution block is about two square feet in area and weighs approximately 100 pounds.

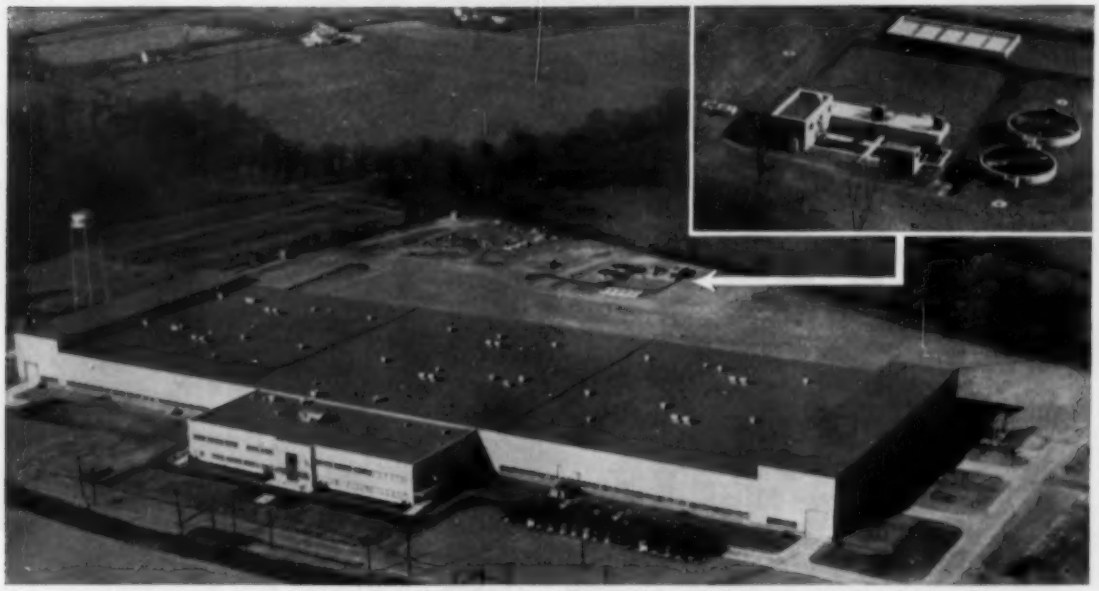
Leopold

We'll be glad to supply details — without obligation

F. B. LEOPOLD CO., INC.
2413 W. CARSON STREET, PITTSBURGH 4, PA.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT · DRY CHEMICAL FEEDERS
FILTER OPERATING TABLES · MIXER EQUIPMENT

VISIT OUR BOOTHS 110-111—AMERICAN WATER WORKS ASSOCIATION—CHICAGO, ILLINOIS—JUNE 12-17



Sewage treatment plant (inset) serves Link-Belt Company Plant at Colmar, 25 miles outside Philadelphia. Except for chemical laboratory used by Sanitary Engineering Dept. for customer service, it's a typical Link-Belt system.

Industries submit samples of wastes for testing at Link-Belt's Colmar chemical lab (in background).

Straightline collectors are used in primary and final settling tanks. Here operator tilts scum pipe.

Clean up industrial wastes

with Link-Belt equipment engineered to your exact needs

TODAY waste treatment must be considered as part of the manufacturing process. In moving from metropolitan areas or locating at rural sites, many plants find it necessary to treat their own liquid industrial and sewage wastes. This is particularly true with increased anti-pollution legislation, both State and Federal.

Link-Belt is a highly qualified designer and manufacturer of waste treatment equipment. More, Link-Belt recommendations represent cumulative judgment acquired in many installations—not only in industrial wastes, but on large municipal water and sewage treatment plants as well. In many cases, Link-Belt's combination of design and quality equipment has enabled industries like steel, chemical processing, canning, packing, paper and many others to reclaim valuable by-products while reducing pollution.

Whether your plant is rural or urban . . . call your nearest Link-Belt office. Our specialists—cooperating with your own engineers, chemists and consultants—will work out the finest in modern water or waste treatment plants for you. Here you can also get expert advice on your complete conveying and power transmission needs.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT 13,700

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

MILWAUKEE

"Makes Sure" WITH TYLOX Rubber PIPE GASKETS

"LEAKPROOF JOINTS" Was What Engineers and Officials Demanded For The City's New Villard Ave. Sewers. They Got Them—With a Tylox Rubber Joint Specification.

With public funds at stake, even the world-wide TYLOX reputation for *no joint-leaks* did not satisfy these officials. The line ran through wet soil areas which invited infiltration troubles. They had to *make sure*, and to get the proof, tests were ordered on flooded sections of completed line.

When we asked the engineers for results of the tests, we were not surprised at the answer . . . "Virtually *no* infiltration . . . We didn't even make a measurement."

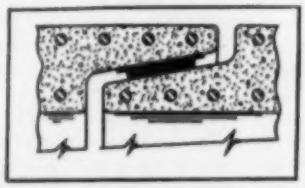
Couple the certainty of "no infiltration" with the other advantages of TYLOX Joints — corrosion resistance . . . quick installation . . . flexibility — and you have the ONE pipe joint that meets requirements of taxpayer, designer and builder alike. Write us today for complete TYLOX information and more case histories. Read the facts, and on your next pipe project "make sure" of no joint leaks with a TYLOX specification.

PROJECT: Villard Avenue sanitary sewers, for Bureau of Sewers, Department of Public Works, Milwaukee, Wisconsin.

ENGINEERS: Lloyd D. Knapp, City Engineer; Edmund Hirsch, Engineer in charge of Sewer Construction Division; Ted Prawdzik, Chief Design Engineer; and Walter Schmitz, Construction Engineer.

PIPE: 21" and 24" reinforced concrete pipe, furnished by Waukesha Cement Tile Co., Waukesha, Wisconsin.

CONTRACTOR: W. J. Lazynski, Inc., Milwaukee, Wis.



This rubber-tight mechanical seal stays tight "for the life of the line."

5003

HAMILTON KENT MANUFACTURING CO.

427 W. Grant St. KENT, OHIO Orchard 3-9555

CLEVELAND Chooses REX®

Cleveland Southerly Sewage Treatment Plant. Havens and Emerson, Consulting Engineers, W. E. Gerdel, Superintendent.

18 power driven chain and scraper skimmers.

Six primary tanks 50′ wide x 126′ long.

OVER 2500 REX CONVEYOR SLUDGE COLLECTORS IN OVER 750 CITIES AND INDUSTRIES...

WHAT BETTER PROOF OF REX SUPERIORITY?

Yes, over 750 cities and industries rely on Rex® Conveyor Sludge Collectors for efficient, dependable and economical operation. These precision-engineered sludge collectors are applicable for all types of sludge-handling or surface-skimming conditions in either sewage, water or industrial waste treatment application...no application is too large or too small...and each receives the full benefit of Rex Engineering.

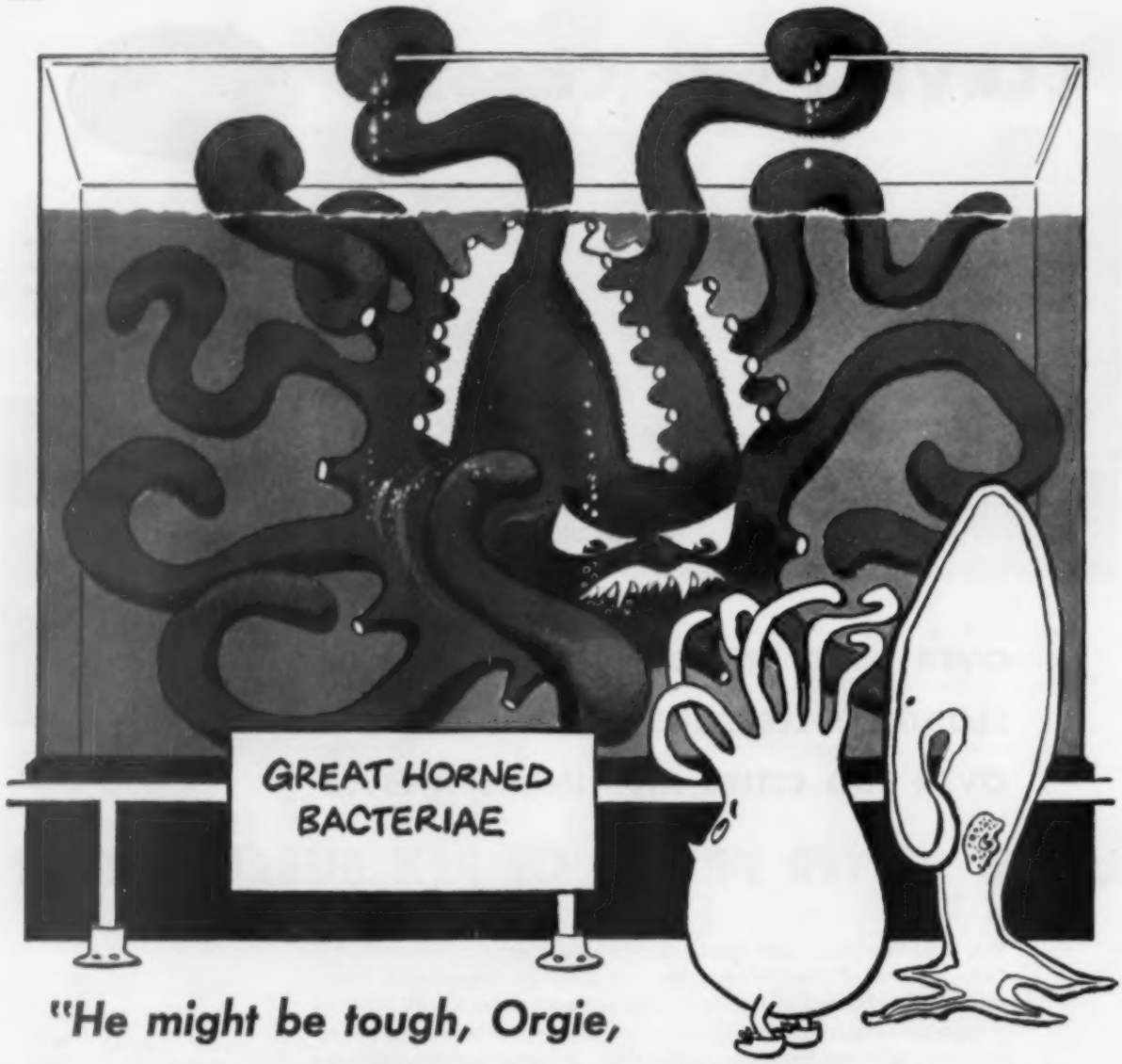
Here are some of the outstanding time-proven features of Rex Sludge Collectors.

- Balanced Equipment Design—design proportionate throughout.
- Rex Z-Metal Chain and Attachments—corrosion and wear resistant.
- Self-Aligning Bearings—easy to install. Compensate for tank irregularities...prevent accumulation of settled solids.
- Offset Split Drive Sprockets—eliminate bulky cantilevered brackets. Easy to replace.
- Centralized, Hardened Wearing Shoes—eliminate splitting strains on wooden scraper flights. Means longer life, lower maintenance.
- Double-Life Sprockets—chain engages only every other sprocket tooth.
- Drive Unit—compact, totally enclosed. Shear pin protection. Jaw clutches provided where independent operation is required.
- Sub-Assemblies—shop assembly of drive units and shaft assemblies assure proper alignment and fit.

MAKE SURE YOU WILL BE THE NEXT ONE to profit from Rex Design and Rex Quality. Get all the facts on Rex Conveyor Sludge Collectors. Call your nearest Rex Sanitation Engineer or write for Bulletin 49-9. Chain Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wisconsin.

REX® CHAIN BELT COMPANY

District Sales Offices in all principal cities



"He might be tough, Orgie, but PITTCHLOR® would handle him in a hurry!"

That's absolutely right! Pittchlor is certain and instant doom to chlorine-susceptible bacteria and algae.

A stable, high-test calcium hypochlorite containing a minimum of 70% available chlorine, Pittchlor works fast and effectively in chlorinating water supplies, treating sewage, or wherever the germicidal and deodorizing action of chlorine is needed.

Pittchlor is dry, white and free-flowing. Its granular form permits ease of application either manually or by mechanical feeders. Write for free folder.

FOR
WATER PURIFICATION
SEWAGE TREATMENT
SWIMMING POOL
SANITATION

Stocked by leading jobbers in 5 lb. resealable cans (9 per case), 3¼ lb. cans (12 per case) and 100 lb. and 130 lb. drums.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte
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IN CANADA: Standard Chemical Limited
and its Commercial Chemicals Division

CHEMICAL PROGRESS WEEK-MAY 16-21
A BETTER AMERICA THROUGH CHEMICAL PROGRESS

BRING ON YOUR RIVERS!

CLOW RIVER-CROSSING CAST IRON PIPE TAKES 'EM "IN STRIDE"!

EASY TO LAY. As easy to make up as a standard flanged joint. Lower labor installation cost because of ease of joint make-up and longer laying lengths.

ONLY A RATCHET WRENCH NEEDED. No split parts. Fewer parts—each joint consisting of one complete pipe, one solid follower ring, one solid ring gasket, bolts and nuts.

FULL 15° TURNING DEFLECTION with absolutely no reduction in the full internal opening area—therefore, no abnormal pressure-drops at deflected joints. Deflection stresses evenly distributed among all the bolts.

LONGER LAYING LENGTHS—approximately 18'6"—faster installation, lower costs. However, lengths may be varied to suit conditions. For example: 6 foot, 12 foot or other special lengths may be advisable to suit required curvature.

Mail coupon for complete information on Clow Ball-and-Socket River-Crossing Pipe. No obligation, naturally.

JAMES B. CLOW & SONS

201-299 North Talman Avenue • Chicago 80, Illinois

☆ Subsidiaries:
Eddy Valve Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Iowa

JAMES B. CLOW & SONS
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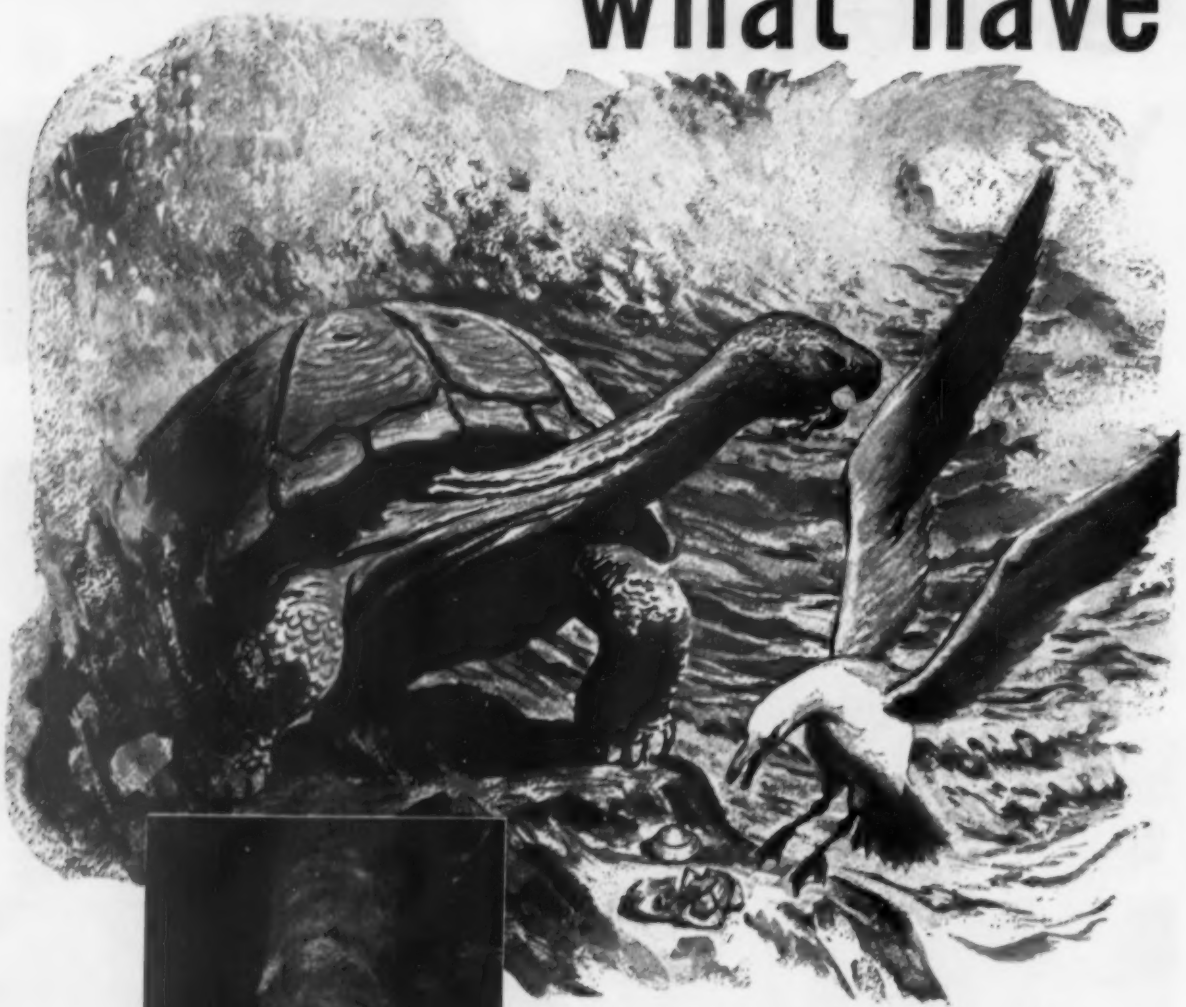
Chicago 80, Illinois

Please send me, without obligation, details and specifications of Clow Ball-and-Socket River-Crossing Pipe.

Company_____
Street Address_____
City_____ Zone____ State____
Individual's Name_____
Position_____

what have



The Galapagos Turtle (or Tortoise) is an inhabitant of the tropics.
It often has a life span of 150 years and weighs up to 500 pounds. Once numerous, its ranks became decimated when man discovered it could live for months without food—making it a good source of fresh meat for sailing vessels, especially whaling ships.

This cast iron water main laid in 1835 by the Bureau of Water of Lancaster is still functioning after 119 years of service.

MODERNIZED cast iron

they in common...

THE TURTLE AND CAST IRON PIPE...LONG LIFE!

The Galapagos Turtle frequently lives to be over 100 . . . an outstanding example of longevity in the animal kingdom. In our everyday world, CAST IRON PIPE lives . . . and serves . . . for centuries.

AND HERE'S THE PROOF: Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

DEPARTMENT OF WATER AND WATER SUPPLY, City of Albany, New York
ALEXANDRIA WATER COMPANY, Alexandria, Virginia
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Baltimore, Maryland
PUBLIC WORKS DEPT., WATER DIVISION, Boston, Massachusetts
DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER, Buffalo, N. Y.
WATER WORKS DEPARTMENT, Chicago
COLUMBIA WATER COMPANY, Columbia, Pennsylvania
BOARD OF WATER COMMISSIONERS, Detroit, Michigan
CITY OF FREDERICK WATER DEPT., Frederick, Maryland
PUBLIC SERVICE COMMISSION, City of Halifax, N.S., Public Water Supply
WATER BUREAU OF THE METROPOLITAN DISTRICT, Hartford, Connecticut
MUNICIPAL WATER WORKS, Huntsville, Alabama
BUREAU OF WATER, Lancaster, Pennsylvania
CITY OF LYNCHBURG WATER DEPARTMENT, Lynchburg, Virginia
MOBILE WATER WORKS COMPANY, Mobile, Alabama
QUEBEC HYDRO-ELECTRIC COMMISSION, Montreal, Quebec
PUBLIC WORKS DEPT., WATER-WORKS & SEWERAGE DIV., Montreal, Quebec
WATERWORKS DEPARTMENT, City of Nashville, Tennessee
DEPT. OF WATER, GAS & ELECTRICITY, New York, New York
DEPT. OF PUBLIC WORKS, BUREAU OF WATER, Philadelphia, Pennsylvania
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Pittsburgh, Pennsylvania
POTTSVILLE WATER COMPANY, Pottsville, Pennsylvania
BUREAU OF WATER, Reading, Pennsylvania
DEPT. OF PUBLIC UTILITIES (WATER), Richmond, Virginia
DIVISION OF WATER & SEWERS, Sacramento, California
WATER & SEWERAGE DEPARTMENT, City of Saint John, N.B.
DEPT. OF PUBLIC UTILITIES, WATER DIVISION, St. Louis, Missouri
WATER DIVISION, DEPT. OF ENGINEERING, Syracuse, New York
DEPT. OF PUBLIC WORKS, Troy, New York
CITY OF UTICA, BOARD OF WATER SUPPLY, Utica, New York
CITY OF WHEELING WATER DEPT., Wheeling, West Virginia
WILMINGTON WATER DEPT., Wilmington, Delaware
WATER DEPARTMENT, City of Winchester, Virginia
WATER DEPARTMENT, City of Winston-Salem, North Carolina
YORK WATER COMPANY, York, Pennsylvania
WATER DEPARTMENT, City of Zanesville, Ohio

TODAY... modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified,* it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

On its record, CAST IRON PIPE is the world's most dependable carrier of water.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

CAST Q IRON

The Q-Check stenciled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS

DE LAVAL pumps America's water...

In Council Bluffs, Iowa, as in more than 80% of America's municipal stations, De Laval centrifugal pumps are faithful public servants.

On the line are two motor-driven De Laval 14/12 units. Each unit has two pumps in series designed for 4,500 gpm against a total head of 245 feet at 1,200 rpm. Another pumping unit, dual driven by a gas engine at one end and a motor at the other, consists of two De Laval 12/10 pumps in series. Operating conditions for these are 3,750 gpm against a head of 235 feet at 1,200 rpm.

Fifty-three years experience in pump building, during which time De Laval has introduced numerous "firsts" in pump design, is the reason for this nation-wide preference.

NOTE:

Have you considered the dollars and cents savings you can make by replacing your old pumps with new, more efficient De Laval units? Write to De Laval for Pump Fax bulletin which includes a valuable "power savings" chart.

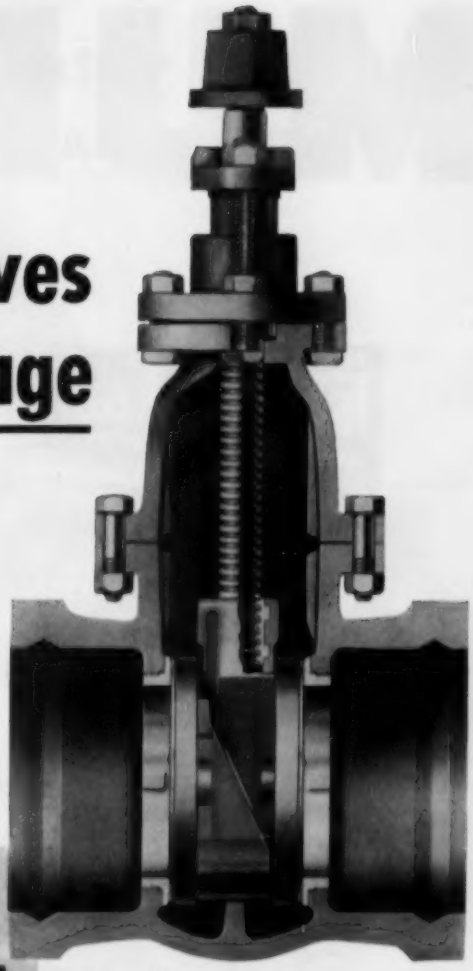
DE LAVAL *Centrifugal Pumps*

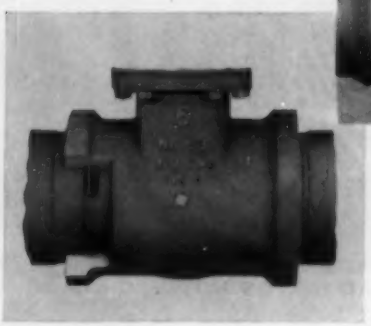
DE LAVAL STEAM TURBINE COMPANY
824 NOTTINGHAM WAY, TRENTON 2, NEW JERSEY

TRADE DARLING MARK

water works valves offer a 3-star advantage

★ *Outstanding performance*
★ *Long life*
★ *Complete selection*





Above: Cutaway of Darling Water Works Valve showing unique fully revolving double disc parallel seat principle, noted for long life, minimum maintenance and drop-tight closure.

Left: Mechanical Joint and Ring-Tite Joint . . . just two of the various valve ends available on Darling Valves.

DARLING'S topmost quality plus the Darling *fully revolving double disc parallel seat principle*, gives you an unbeatable combination.

The cutaway view shows Darling's simple gate arrangement with its plain no-pocket discs and wedges. These unique features, greatly lengthen disc and seat life, minimize maintenance and assure easy, tight closure and long life.

Conforming to A.W.W.A. specifications and available in sizes for your particular service, these valves are equipped with ends designed to meet your installation needs.

That's what we mean by a 3-star advantage. For detailed facts, send for Bulletin 5403.

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

MUELLER®

INVITES YOU

TO VISIT BOOTHS 86, 87 AND 88 AT THE SEVENTY-FIFTH ANNUAL CONVENTION OF THE AMERICAN WATER WORKS ASSOCIATION — JUNE 12TH. THROUGH JUNE 17TH.

REPRESENTATIVE ITEMS OF THE COMPLETE LINE OF WATER WORKS EQUIPMENT, SUPPLIES AND SPECIALTIES OFFERED BY MUELLER CO. WILL BE ON EXHIBIT.

CONRAD HILTON HOTEL, CHICAGO, ILLINOIS

Let us show you the new Mueller Cut-in Sleeve and Valve and where and how it fits into your system.

MUELLER CO. *Dependable since 1857* **DECATUR, ILL.**

FACTORIES & OFFICES AT DECATUR · CHATTANOOGA · LOS ANGELES · BARNIA, ONTARIO

Dependable water storage—

AN ESSENTIAL PART OF ATLANTIC CITY'S WELCOME TO THE WORLD

PITTSBURGH
·DES MOINES

Elevated Steel Tanks

As host to millions, Atlantic City spares no effort to protect the health and safety of its guests. The resort's latest addition to better water service is this 1,000,000-gallon Pittsburgh-Des Moines Elevated Steel Tank. Of radial-cone design, the tank measures 71 feet in diameter, has a 35-foot head range, and tower height 80 feet to bottom. • Write for our "Modern Water Storage" brochure.

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) ..... 3418 Neville Island
NEWARK (2) ..... 218 Industrial Office Bldg.
CHICAGO (3) .. 1222 First National Bank Bldg.
LOS ANGELES (48) ..... 6399 Wilshire Blvd.
DES MOINES (8) ..... 919 Tuttle Street
DALLAS (1) ..... 1223 Praetorian Bldg.
SEATTLE ..... 526 Lane Street
SANTA CLARA, CAL. ..... 625 Alviso Road

YOU'VE TRIED THE OTHERS AT YOUR EXPENSE
NOW TRY THE F&P CHLORINATOR

. . . AT MY EXPENSE

"Because there are so many good and valid reasons why our Chlorinator merits your deep consideration, I'm signing this advertisement. I am Kermit Fischer, President of Fischer & Porter Company.

Fischer & Porter Company has been in business since 1937, making chlorine control systems for all of the eighteen years since then. In 1949, after years of experimentation and development, we put our first 'packaged unit' chlorinator into service at Winter Park, Florida waterworks — where it has been operating successfully ever since. In May of 1952 we retooled our chlorinator production, incorporating into our basic design all the improvements made possible through the experience gained at Winter Park and some fifty other installations. Now there are more than 1000 of the new model F&P Chlorinators in daily use—and all our customers tell us it is the best chlorinator they have ever used.

HERE ARE SEVEN REASONS WHY I CAN MAKE THIS GUARANTEE OFFER TO YOU WITH CONFIDENCE . . .

1. SAFEST . . . The F&P Chlorinator is completely safe because it uses instantaneously operating mechanical instrument type safety devices. Any malfunctioning shuts off the chlorine supply instantaneously—but the chlorinator automatically starts operating again when the trouble has been corrected. There are no bell jars—exposed or otherwise—with water seals, so there are not the time delays these outmoded components introduce to the safety system.

2. MOST DEPENDABLE . . . Many F&P Chlorinators have operated for over a year at a time without being shut down for any repairs or replacement parts or for cleaning. Even connecting chlorine to the water inlet and water to the chlorine inlet did not faze one customer's chlorinator. After the connections were reversed, the chlorine system sucked itself dry and the chlorinator started up automatically.

3. MUCH LOWER FIRST COST . . . Simplified design, mass production methods, *mechanical* principle of operation, modern instrument engineering, make it possible to supply the new F&P Chlorinator at far lower first cost than the old hydraulic bell jar chlorinators.

4. MUCH LOWER MAINTENANCE COST . . . Not one, not a dozen, but *every* present user of F&P Chlorinators has stated unequivocally that the F&P Chlorinator cuts the maintenance bill to nil—whereas formerly maintenance cost was a major item.

5. NO CORROSION, NO SCRAPING, NO PAINTING . . . Because the cabinet is made entirely of fibre glass—without any internal metal bracing—it cannot corrode, does not have any paint or other finish coat to be renewed. *All* the internal parts are also completely resistant to attack by chlorine, by water or wet mixtures of the two so there is nothing to deteriorate, nothing to scrape, nothing to repair.

6. SIMPLEST TO OPERATE . . . The F&P Chlorinator is so simple that no skill is required either to operate or install. No foundation, no bolting. Just attach piping to the connections labeled 'chlorine,' 'water,' 'drain' and 'vent'—then turn on the chlorine and water valves (either one first) and you're off. Anybody can do it. Anything he does wrong (if he can find something wrong to do) simply shuts down the chlorinator.

7. PROVEN IN USE 1000 TIMES OVER . . . Sales of F&P Chlorinators have increased by leaps and bounds. Over 1000 present users are all saving money day in and day out.

These are provable and proven facts. We can give you every evidence you need of user satisfaction. But I still want you to make up your mind on the F&P Chlorinator, by actual test, *under your own operating conditions.*

All I ask is that you write to me now. Don't wait for repair bills or breakdown to start you thinking about better chlorination equipment. Merely tell me your chlorine capacity requirements, your ejector water supply pressure, your solution discharge pressure and I'll do the rest. You'll be under no obligation whatsoever. I stand on my faith in our Chlorinator. I know that it will win your enthusiastic support, that it will outperform any other chlorinator ever offered. All I ask is that you convince yourself—by trying it at no cost to you.

Will you write to me today—and ask me to prove what I say—*right in your own plant*—under your own operating conditions?"

Kermit Fischer

President.

complete process instrumentation

FP **FISCHER & PORTER CO.**

155 Fischer Road, Hatboro, Penna.

LA1014

18 YRS. EXPERIENCE SUCCESSFULLY MANUFACTURING CHLORINE FLOW METERING EQUIPMENT

EASY ALIGNMENT!

Pipe deflections—resulting from varying flange thicknesses and restricted bolt play—presented no problem to engineers designing Cleveland's 22 million dollar Nottingham Filtration Plant. In joining cone valves to a 36″ wash water line, for example, they specified Dresser Couplings which permit up to 3° deflection, yet maintain watertight joints.

In addition, Dresser Couplings provide easy entrance into the line, simplify maintaining and replacing the valves.

For information on Dresser Coupling applications that may suggest new solutions to old problems—help you get a *superior* job on water, sewage and industrial waste projects—contact your local piping supply house or write us.

DRESSER.

DRESSER MANUFACTURING COMPANY, LTD.
(One of the Dresser Industries)
69 Fisher Street
Toronto 4, Ontario, Canada

How Rockwell Is Anticipating The Growing Needs of Water Utilities...

● FACTORIES

Barberton, Ohio
Bellefontaine, Ohio
Brooklyn, N.Y.
Dubois, Pa.
East Chicago, Ind.
Hopewell, N.J.
Knox, Ind.
Norwalk, Ohio
Oakland, Calif.
Pittsburgh, Pa.
Sulphur Springs, Tex.
Tupelo, Miss.
Tulsa, Okla.
Uniontown, Pa.

▲ WAREHOUSES

Atlanta
Boston
Chicago
Houston
Kansas City
Los Angeles
Tulsa
Seattle

■ SALES OFFICES

Atlanta
Boston
Charlotte
Chicago
Dallas
Denver
Houston
Kansas City
Los Angeles
Midland, Tex.
New York
Philadelphia
Pittsburgh
San Francisco
Seattle
Shreveport
Tulsa

L. A. DIXON, JR., *Vice President, Meter and Valve Division,* says:
"We are better equipped, better stocked and better staffed than ever before to furnish the right kind of meters you need, when you need them!"

•New Factories •More Warehouses •Bigger Sales Staff

Improvement and expansion are the order of the day and we at Rockwell have accepted the challenge. To take care of increasing demands for Rockwell water meters, we have built and are now operating an entirely new factory in Uniontown, Pa.

Getting new meters, meter parts and valves into your hands when and as you need them is another problem we have faced and solved. Now, warehouse stocks of all popular sizes and types are maintained at eight convenient locations throughout the country.

We have also multiplied our degree of personal service to your needs. Nearly twice as many Rockwell men travel the country as formerly. You'll find them better informed and of greater help through having been soundly schooled and trained in all phases of water measurement.

Yes, we at Rockwell are prepared for a period of growth and expansion unparalleled in the history of water distribution. We invite you to make the best use of our equipment and facilities in the days and years ahead.

H. GOTTWALD
Eastern Regional Manager

J. W. NORTHCUTT
Southern Regional Manager

C. C. MOORE
Central Regional Manager

R. R. BUSH
Midwestern Regional Manager

W. R. McLAUGHLIN
Southwestern Regional Manager

H. BOEZINGER
Western Regional Manager

J. F. O'GRADY
Manager Water Products

ON THE NEXT PAGE . . . Courtney Shenkle, Factory Manager, tells you about the new Rockwell water meter plant at Uniontown, Pa.

New Rockwell Water Meter

COURTNEY SHENKLE, *Factory Manager, Uniontown, Pa. says:*
"I'm proud of this plant, its people, and, most important, the high degree of precision we are building into Rockwell water meters."

Plant Now In Full Operation

OVER $2 MILLION INVESTED TO BRING A BETTER FUTURE TO WATER METER USERS

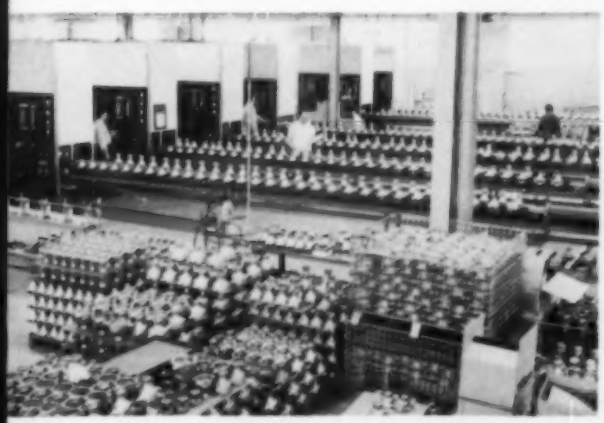
Designed For Precision Production

This new Rockwell plant was laid out and completely tooled for one specific purpose . . . to produce the finest water meters it is possible to make. In every phase of manufacture the most modern methods and machinery are used. And to safeguard consistent high quality, every practical piece of inspection equipment is at hand to chemically and physically control the materials used . . . to assure dimensional exactitude in the finished parts. All this means meters that will measure at top accuracy for longer periods and at lower costs . . . the kind of meters *you* need to cut maintenance and increase revenue.

Our huge investment in this new plant and equipment is solid evidence of our faith in the future and growth of the water utilities. It is a confidence you can share in your plans for the improvement and expansion of your own operations.

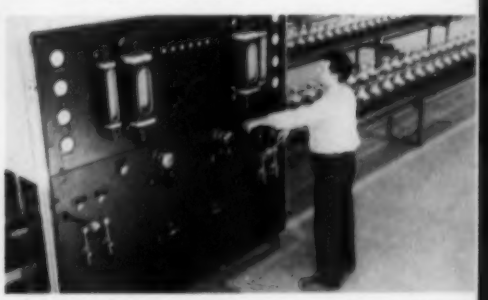
For light machining, Rockwell-built Delta drill presses provide flexibility and accuracy.

Previously sub-assembled parts are fitted into meter cases at this station.



Multiple test stands, especially developed by Rockwell engineers for proving accuracy before shipment.

This huge automatic machine performs seven different operations on a meter case.

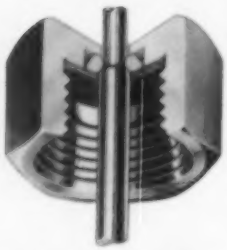


Operator at test stand panel controls rate of flow and water pressure. Meters can be tested at three times the pressure normally encountered.

ON THE NEXT PAGE . . . C. K. Madison tells you about the Rockwell research and development program.

Rockwell Engineering Is Always First With The Finest In Design Improvements

"O"-Ring
STUFFING BOX NUT
ASSEMBLY



Eliminates Leaks,
Binds, Troubles, Expense

In the Rockwell organization, research and development is budgeted at a substantial figure in our tabulation of operating expense. Planning ahead, searching for better meter designs and improved meter components is a never-ending process. From this program, which involves both our own laboratories and Research Fellowships, have come many significant developments that either enhance water meter performance or add to the value customers receive from our products. It's a carefully conceived program designed to improve the economic future of water distribution and to increase our usefulness to the water works industry.

C. K. MADISON, *Vice President, says:*
"In my 30 years' experience with water meters, I consider our new O-Ring stuffing box assembly the greatest single improvement ever developed."

Rockwell Products For Water Utilities

Rockwell Arctic Meter

Rockwell Empire Type 12 Meter

Rockwell Empire Type 14 Meter

Rockwell Eureka "B" Meter

Rockwell Tropic Meter

Rockwell
Single Registor Meter

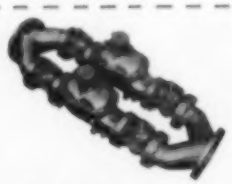
Rockwell Type 6 Meter

Rockwell Empire Type 16
Meter

Rockwell-Nordstrom
Service Cock

Rockwell-Nordstrom
Standard Valve

Rockwell-Nordstrom Gear
Operated Valve



Rockwell Manifold
Compound Meter Unit

ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PENNSYLVANIA

Atlanta Boston Charlotte Chicago Dallas Denver Houston Los Angeles Midland, Texas
New York Kansas City, Mo. Philadelphia Pittsburgh San Francisco Seattle Shreveport Tulsa

DRINKING WATER . . . *almost!*

Houston's water supply once came entirely from wells. But in recent years the underground reservoirs have steadily been depleted while the demand for water—by agriculture, industry and municipalities—has steadily grown. Like many areas in the country, Southeast Texas faces the need of supplementing its water tables with supplies of surface water.

Accordingly, the City of Houston has built dams and reservoirs on the San Jacinto River to help retain the precious rainwater which previously ran out to sea, wasted. But surface water, unlike well water, contains silt . . . so much silt that even when there is no turbulence, it is plainly visible.

To rid water of this suspended matter—visible *and* invisible—is the job for a filtering agent: alum.

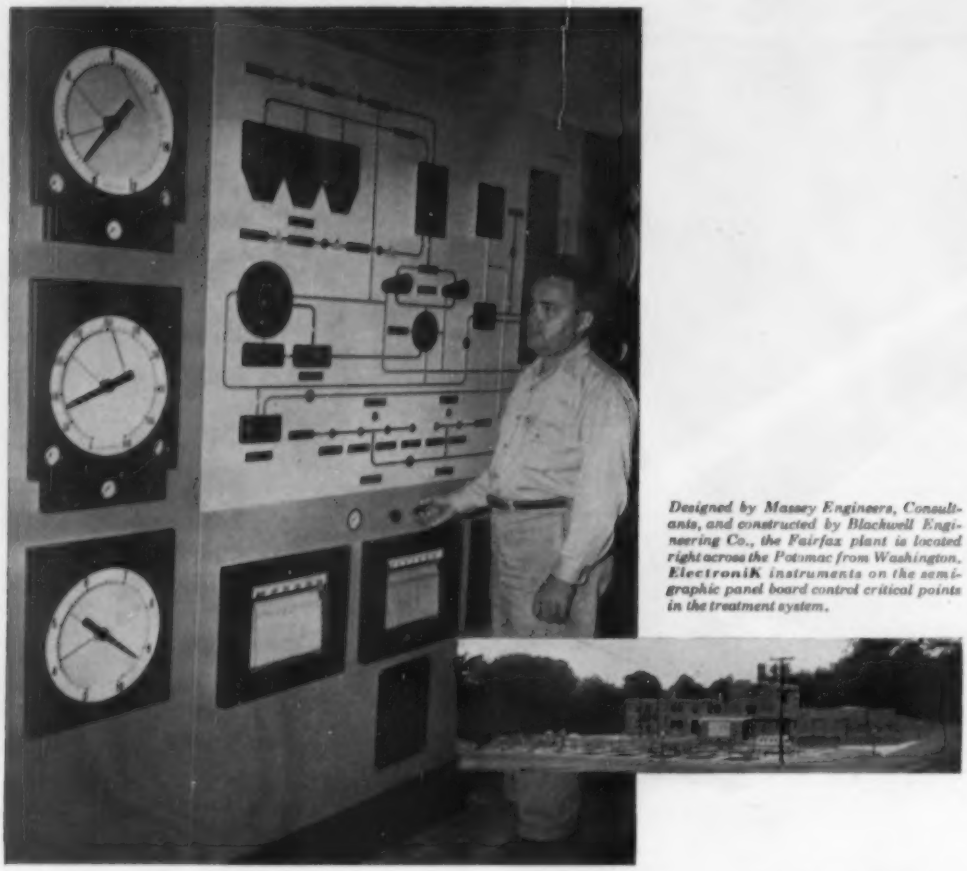
Consolidated takes pride in being in a position to supply liquid alum from its recently completed plant at Houston for Houston's municipal water system.

CONSOLIDATED CHEMICAL INDUSTRIES INC.

640 ESPERSON BUILDING • HOUSTON 2, TEXAS

380 MADISON AVE. • NEW YORK 17, NEW YORK

5402



Designed by Massey Engineers, Consultants, and constructed by Blackwell Engineering Co., the Fairfax plant is located right across the Potomac from Washington. ElectroniK instruments on the semi-graphic panel board control critical points in the treatment system.

Brown instruments guide critical processes in Fairfax County's new plant

The $1.5 million sewage treatment plant, comprising many unique features, just completed by Fairfax County, Virginia, is making a big contribution toward cleaning up the Potomac. Designed to care for a community of 80,000, this modern plant makes good use of the most up-to-date treatment techniques . . . including accurate, automatic supervision of critical operations by Brown instruments.

ElectroniK instruments control temperatures in the sludge dryers, to assure thorough moisture removal at maximum fuel economy. Another *ElectroniK* instrument records pH of effluent as a final check on overall system performance. Multi-point *ElectroniK* recorders provide continuous spot checks of other vital plant temperatures, to guide operators in supervising processes.

The leading choice of designers and consultants in the water and sewage treatment field, Brown instrumentation has been selected for many of the country's outstanding installations. This diversified line of equipment covers practically every requirement of modern treatment processes . . . and it is backed by prompt, competent service from some 90 Honeywell service centers.

Your local Honeywell sales engineer will welcome the opportunity to discuss specific requirements with you and your consulting engineer. Call him today . . . he's as near as your phone.

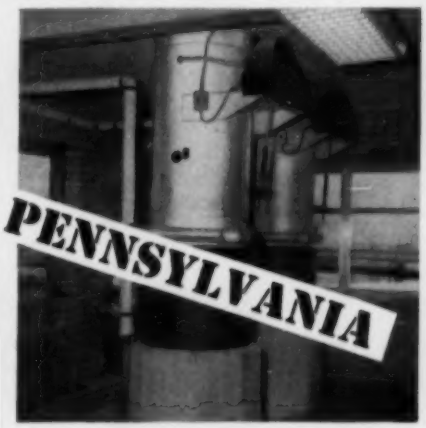
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:** Write for Bulletin 7302, "Instrumentation for Water, Sewage and Industrial Waste Treatment"

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls



Universal in name... service... usefulness...

If you took a poll of the chemical feeders in water works service throughout the country, you would have dramatic proof of the popularity of Omega Universal Feeders. Here are a few of the hundreds of Universal Feeders which, today, are solving the chemical feeding problems of cities and towns in every state of the Union.

Are you acquainted with the many features of Omega Universal Feeders? If not, write for Bulletin 20-J10A.

Omega Machine Company, 350 Harris Ave., Providence 1, Rhode Island.

OMEGA *THE LAST WORD IN* **FEEDERS**

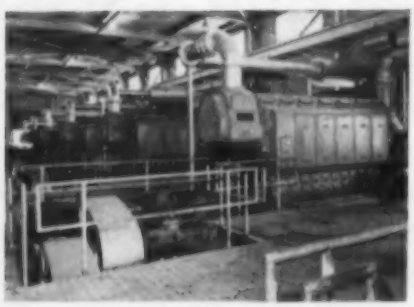
DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • BUILDERS-PROVIDENCE, INC.

B-I-F METERS FEEDERS CONTROLS

World's largest pumping station tames Everglades

Each giant 89-ton pump is equal to the floor space of the average-sized living room. The huge four-bladed, air-foil propeller moves water through the pump at the rate of 360,000 gallons a minute.



Six 1600-hp. Fairbanks-Morse Opposed Piston Diesel Engines insure uninterrupted power for the big pumps, especially during storm periods when they will be most urgently needed.

Floridians who have counted their flood loss in thousands of lives and millions of dollars bitterly refer to Lake Okeechobee as the Killer Lake.

Now, with the completion of the world's largest self-powered pumping station, there is the promise of forever taming the Everglades' rampaging waters.

Located at the southern tip of the lake, the station houses six of the world's largest pumps . . . built by Fairbanks-Morse . . . powered by Fairbanks-Morse Opposed Piston Diesel Engines.

Each pump can deliver over 500 million gallons a day. That's more water than is consumed each day by the entire population of Florida. Put all six of these giant 89-ton pumps in operation and you can pump nearly three times the daily consumption of the city of New York.

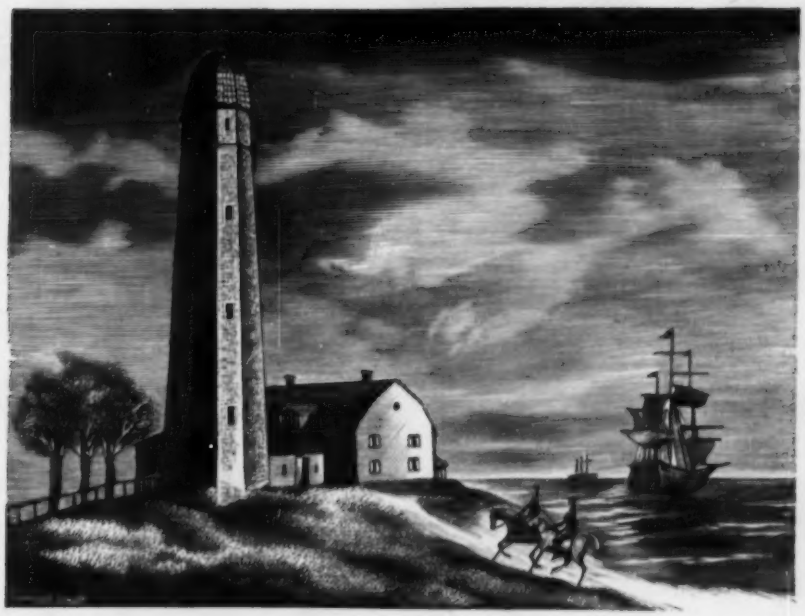
We at Fairbanks-Morse are proud to be a part of one of the largest engineering projects on the face of the earth—and the country-wide acceptance it typifies. This endorsement and wide selection in the F-M line of 50,000 pump models assures you of finding the *one* pump best suited to your pumping requirements. When next you need a pump, look for the one made by the world's largest pump manufacturer—Fairbanks-Morse. Ask your nearby Fairbanks-Morse Field Pump Engineer for assistance on your specific problem, or write to Fairbanks, Morse & Co., 3601 Kansas Avenue, Kansas City, Kansas.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • WATER SYSTEMS • GENERATING SETS • MOWERS • MAGNETOS • MOTORS • SCALES • DIESEL LOCOMOTIVES AND ENGINES

FAMOUS LIGHTHOUSES OF AMERICA

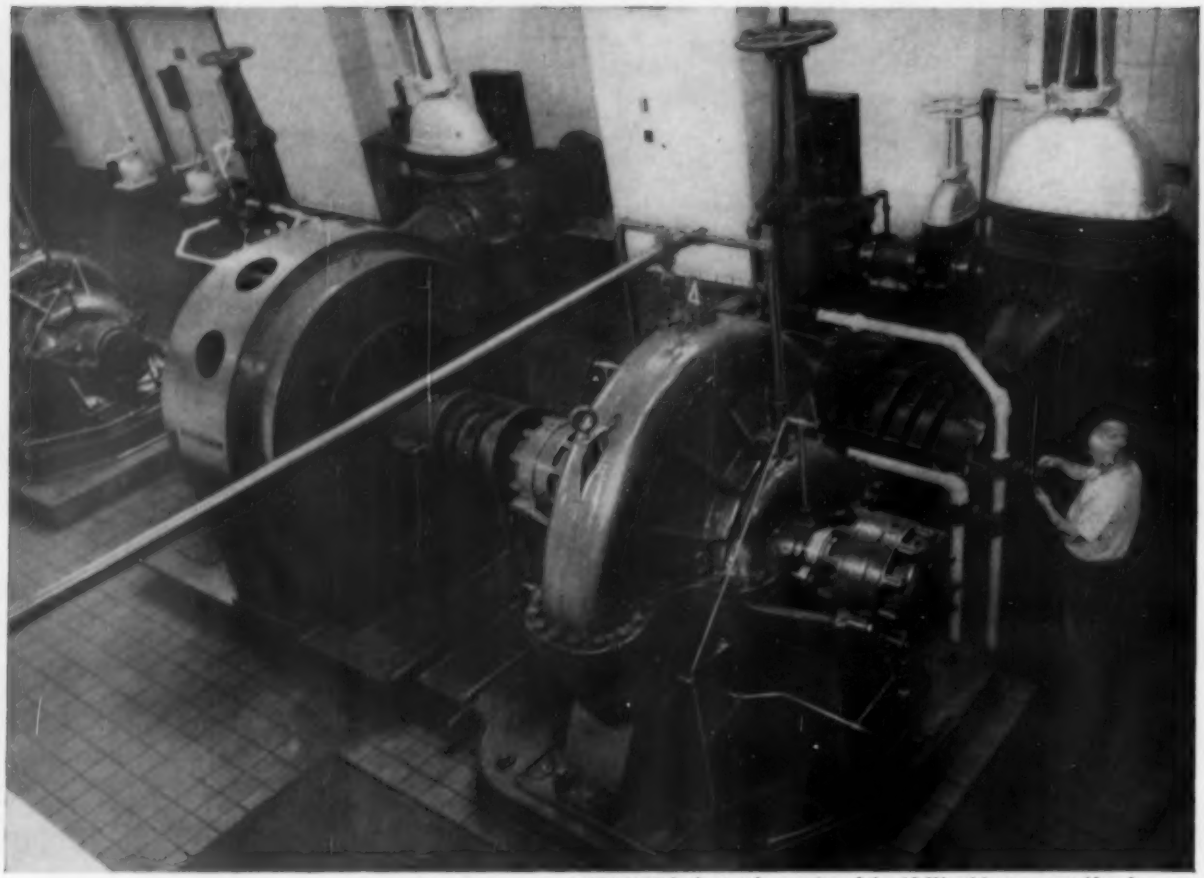


SANDY HOOK LIGHTHOUSE, built in 1764 by the Colony of New York, is the oldest original light tower in use in the United States. A massive structure, octagonal in form with walls of stone seven feet thick at the base, it stands today as it was built except for an added inner lining of brick. This famous lighthouse is located on a narrow peninsula on the New Jersey coast sixteen miles due south of New York City and still helps to guide ships into New York's lower bay.

Sure guidance for users of electrochemicals is the long-recognized quality of Niagara Alkali products. A pioneer in this field, Niagara has helped manufacturers improve their products and the efficiency of their processes through the use of Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, N. Y.



215 MGD is the total capacity of the 10 Worthington centrifugal pumps on the job in Philadelphia's modern Torresdale Station.

Philadelphia's newest pumping station has 10 Worthington centrifugals

Back in 1800 Philadelphians got along on 700,000 gallons of water a day.

It was pumped through 35 miles of wooden pipes from America's first municipally owned pumping station, located where City Hall now stands.

Today the city's water system has reached the point where just one of its 16 pumping stations — the modern Torresdale Station — can pump 215 million gallons of water a day into the 70-square-mile area it serves. That gallonage is the capacity of Torresdale's 10 electric-motor-driven Worthington centrifugal pumps which range in horsepower from 250 to 1750.

This is one more example of the tough assignments handed to Worthington water works equipment these days by municipalities on all sides. Whether the need is for pumps, comminutors, Diesels or turbines, there's a Worthington unit with design and construction features tested on a thousand jobs. There's more to be said, of course, and it's all in Bulletin WP-1099-B60. Write for it to Worthington Corporation, Public Works Division, Harrison, New Jersey, or get in touch with your nearest Worthington district office. W.4.2

WORTHINGTON

ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps

ACT NOW!

eliminate "orphans" from your fire protection system . . . with

IOWA

GATE VALVES and FIRE HYDRANTS

Don't Gamble on Obsolete Equipment

...BE READY FOR ANY EMERGENCY!

"Forever" is such a long, long time. In this H-bomb age, we hesitate to promise that replacement parts for Iowa Hydrants and Gate Valves will be available "forever." But we'd like to—because, actually, replacements are readily available today for every part of every hydrant and gate valve Iowa ever has made. That's a record that extends way back to 1909—almost a half century ago. It's a record we plan to maintain. So, this much we can say: You're as "safe as safe can be" in replacing NOW with time-proved Iowa. For full details, please write TODAY!

IOWA HYDRANTS

Provide full, truly unrestricted water way.

Open with the pressure for faster water delivery.

Close against the pressure to eliminate water hammer, provide flushing action.

Assure positive drainage.

Are available for any type of connection.

All working parts removable through top—no digging or special tools required.

Meet all A.W.W.A. specifications.

IOWA GATE VALVES

Double disc, parallel seat.

Positive wedging action for efficient, no-leak closing.

Gates hung loosely from stem nut—no binding.

Rugged, time-proved design means long life, low service costs.

Available with bell, flange, or mechanical joint connections to fit any existing or planned installation.

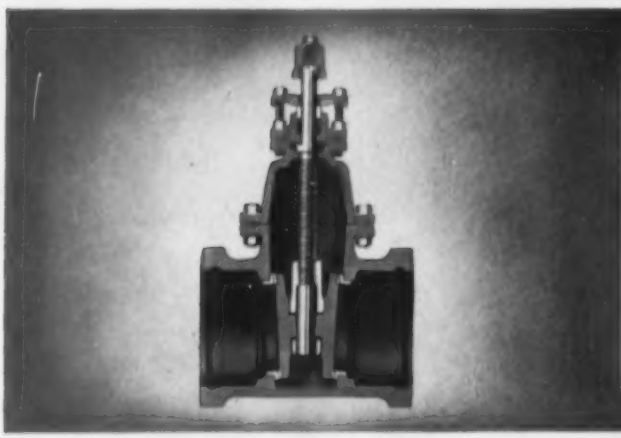
Meet all A.W.W.A. specifications.

IOWA VALVE COMPANY

Oskaloosa, Iowa • *A Subsidiary of James B. Clow & Sons*

R. D. WOOD GATE VALVES PROVIDE POSITIVE FLOW CONTROL AFTER YEARS IN THE LINES

Here's what the R. D. Wood Gate Valve looks like from the outside — rugged, simple, streamlined. It is built for generations of dependable service in the lines. Available with all pipe connections, including mechanical joint.



Strip it down to a sectional view and you can see why interruptions in service are rare. There's virtually nothing to go wrong — none of the complicated small parts that fail in an emergency because sediment and scale render them inoperable.

Bring the R. D. Wood Gate Valve down to its essentials and you have the spreader and two discs. Rising or descending, discs are free to revolve completely, thus distributing wear evenly. In closing, discs are fully lowered before spreading action begins. Fully opened, components move out of the water way, providing full pipe capacity.

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Phila. 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

Floating on the line...

Hortonsphere means new efficiency at sewage treatment plant

40-ft. diam. Hortonsphere at Benton Harbor, St. Joseph, Michigan, sewage treatment plant.

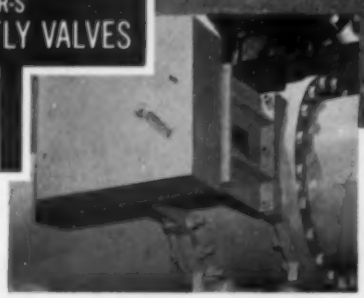
At the Benton Harbor, St. Joseph, Michigan, sewage treatment plant, as at many modern sewage treatment plants, digester gas is used as fuel for operation of the plant. To equalize the variable gas production with the demand, a 40-ft. diameter Hortonsphere® was installed. When gas is produced at a higher rate than usage, it is stored in the Hortonsphere. When the demand exceeds the supply, gas flows from the sphere to meet the demand. A system such as this permits the most efficient use of all gas produced.

Further information, estimates or quotations on a Hortonsphere, or other welded steel plate structures may be obtained by writing our nearest office.

CBI

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.



66 R-S Rubber-Seated Butterfly Valves, in sizes from 14" to 54", are used with hydraulic and manual operation in the new Filtration Plant.

Engineers:
Greeley and Hansen, Chicago

NIAGARA FALLS, N.Y. RELIES ON RUGGED R-S RUBBER-SEATED BUTTERFLY VALVES

The new Niagara Falls Pumping Station and 32 MGD Filtration Plant is one of the few big plants in the country almost entirely equipped with butterfly and cone valves. At this Filtration Plant, for instance, 66 R-S Rubber-Seated Butterfly Valves were specified for their ability to provide drop-tite, shut-off compactness and ease of operation. Satisfactory performance since the plant began operation in 1953 has resulted in an additional order of 42 R-S Rubber-Seated Butterfly Valves to rehabilitate the old Niagara Falls Filtration Plant.

Positive closure is assured by the wedging action of the valve disc periphery against a tough, flexible rubber seat, which seals the shaft bosses as well. Specially compounded rubber defies abrasion and resistance to the flow of materials for longer valve life.

If you would like to benefit by the design advantages and economics available in our complete line of butterfly, cone and ball valves, contact our local representative or write S. Morgan Smith Company, York, Pennsylvania.

S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH CANADA, LIMITED, TORONTO

Hydraulic Turbines
Pumps
Gates & Hoists
Trash Rakes
Accessories

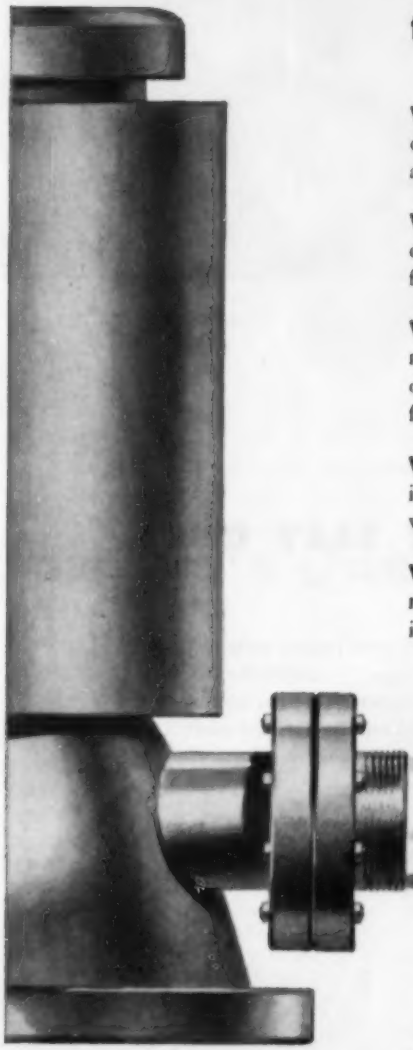
HYDRODYNAMICS

Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

for cleaning and developing water wells

WELTONE

the complete well cleaning preparation



WELTONE is a complete well cleaning product that combines the exclusive dispersing action of Calgon* with several other chemicals into a highly soluble, effective powder.

WELTONE IS SAFE . . . will not harm metals or concrete during the contact period, allowing cleaning with the pump in place. Weltone forms no dangerous fumes.

WELTONE IS EFFICIENT . . . at cleaning old wells or developing new wells. The high dispersive activity of Weltone effectively removes drilling muds, and the quartz, mica, silt and other materials which frequently prevent new wells from developing their full capacity.

WELTONE STERILIZES . . . and disinfects, destroying the growths of iron fixing or other bacteria which frequently contribute to lowered well capacities.

WELTONE IS EASY TO USE . . . specially processed to dissolve readily, Weltone may be added directly to the well in dry form. Use inexpensive Weltone to keep water wells at high capacity.

Write today for full information on Weltone. The descriptive folder is free, and contains complete information on the remarkable well cleaning properties of Weltone.

CALGON, Inc.

HAGAN BUILDING • PITTSBURGH 30, PA.

*Calgon is the registered trademark of Calgon, Inc., for its sodium phosphate glass (sodium hexametaphosphate) products.

In Price Purchasing

THE DOWN PAYMENT

MIGHT BE THE ONLY EASY ONE

The purchase of water meters involves more important economic factors than price alone. Actually, the bid price is only your down payment . . . and it could well be the only easy payment.

Any instrument loses its accuracy as it wears. After a few years . . . maybe only a few months . . . an improperly selected meter begins to lose revenue. In time, you'll also have high repair costs . . . or costly scrap-and-replace programs.

Avoid these high costs with Trident meters. Tridents retain accuracy longer . . . derive maximum revenue longer. Most important, you avoid high costs of obsolescence and repair. The most modern Trident parts fit the oldest Tridents you have. You actually modernize as you repair . . . with Trident.

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WATER & SEWAGE WORKS

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UNDER CONSTRUCTION—Chicago's new 960 mgd Central District Filtration Plant will cost $85 million

Chicago's Quest for Potable Water

by LANGDON PEARSE

Mr. Pearse is Sanitary Engineer, The Sanitary District of Chicago. His paper was prepared as a contribution to document 1955 WHO World Health Day. It is an historical resume' of Chicago's water supply development, integrated with planning of the Sanitary District to handle the City's sewage.

THIS is the story of the remarkable growth of the City of Chicago, in a period of 150 years, from a frontier fort built in 1803 as an Indian trading post, to one of the large cities of the world, with over 3,600,000 inhabitants in 1950. It now is the center of a large industrial empire, served by shipping and some thirty-five railroads.

The quest for a safe drinking water and the disposal of its sewage runs concurrently with the development of sanitary practice, in which Chicago and The Sanitary District of Chicago have been an active factor.

At the beginning of the settlement of what is now known as the Middle West, Fort Dearborn was established in 1803 as an Indian trading post at the eastern limits of a vast wilderness, relatively unexplored. The Fort was located on a knoll at the mouth of the Chicago River, where the river entered Lake Michigan, and was garrisoned by an army captain and some fifty-seven men. The location provided a practically inexhaustible supply of water, as well as access for navigation. In 1812, the garrison was massacred by Indians, who burned the Fort and drove off the few settlers who had arrived since 1804. The Fort was rebuilt in 1817-1822 and a canal was surveyed from the lake to the Illinois River to provide access to the Mississippi River.

The settlement grew until on August 4, 1830, a survey plat was filed, the first date in Chicago's corporate history. A year later Chicago was designated as the seat of Cook County. The enormous mushroom growth of the modern city began in 1833, when Chicago was incorporated as a town, with a population of less than 200. A wild era of land speculation ensued. On March 4, 1837, Chicago was incorporated as a city, and from then on grew apace until in 1856 it embraced 18 sq. miles and was trying vigorously to pull itself out of the mud. In 1855, the streets were elevated 12 feet and the surrounding lots filled in.

Water Supply and Sewerage

At first Chicago depended on cisterns and dug-wells for its water supply. On January 18, 1836, the Chicago

OLD and NEW—Dever and Harrison intake cribs in Lake Michigan

Hydraulic Co. was incorporated and started construction of a water works in 1840. In 1852, Chicago took over the Water Company and began the construction of its own works, which went into operation in February, 1854. Thereupon the need for sewers became imperative.

In 1855, E. S. Chesbrough made a report on sewerage and sewage disposal for Chicago (then about 13.5 sq. mi. in area), probably the first complete report of its kind made for an American city and certainly the first in recommending a systematic plan for sewage disposal. A succession of epidemics of cholera and dysentery for several years led, in February, 1855, to the passage of an act by the Illinois legislature creating the Chicago Board of Sewer (Sewerage) Commissioners. Chesbrough resigned as City Engineer of Boston on October 1, 1855, and migrated to Chicago. He developed his plan for Chicago sewerage for submission to the Sewerage Commission on December 26, 1855, when Chicago had an area of about 18.0 sq. mi. and a population around 69,610. Chesbrough considered four plans for the drainage of the city:

(1) Into the (Chicago) river and its branches directly, and thence into the lake.

(2) Directly into Lake Michigan.

(3) Into artificial reservoirs, to be thence pumped up and used as manure (sewage farming).

(4) Into the Chicago River, and thence by the proposed steamboat canal into the Illinois River.

Chicago River for Sewage Disposal

As least expensive, Chesbrough recommended the first plan—discharge into the river and thence into the lake, although he realized the plan might endanger the health of the city, especially during warm dry portions of the year, and also might fill up the river to obstruct navigation. But he proposed to alleviate the first objection by pouring into the river from the lake a sufficient body of water to prevent offensive or injurious exhalations.

Chesbrough also proposed to—

> "supply the main sewers with a constant current of fresh water by pumping from the lake to a height of 8 to 10 ft., and in the west district, by draining directly from the Canal at Bridgeport to keep water in the South Branch fresh, especially during the warm months of the year, and to construct a canal 20 ft. wide and 6 ft. deep at low water between the lake and the South Branch."

His objections to the second plan (discharge directly into the lake) were:

(1) The supposed effect on the water with which the citizens are supplied from the lake, if any of the (sewer) outlets should be near the pumping station;

(2) The greater length of sewers required, and, consequently, the greater cost;

(3) The difficulty in stormy weather of preventing the outlets from injury or from being obstructed by snow and ice.

His objections to the third plan were:

(1) Great uncertainty of a sufficient demand for sewage to pay for the cost of distribution;

(2) The great evil that would result from a failure of the reservoirs to provide sufficient capacity and the expense of the reservoirs if of ample capacity;

(3) Danger to the health of the city from winds that would blow from the area in which the sewage was spread over a wide surface.

As to Plan 4 (draining into the proposed steamboat canal and thence into the Illinois River), Chesbrough believed this was too remote to be relied upon in 1855.

Although Chesbrough named as an objection to his second plan the discharge of sewage directly into the lake, indicating the danger to the water supply, then taken from a point near the shore, he did not enlarge upon it. In those days (circa 1855) supposed airborne rather than waterborne menaces were of deeper concern.

Pollution and Waterborne Disease

Unappreciated and unforeseen by Chesbrough, the discharge of ever-increasing volumes of sewage into the Chicago River caused a great local nuisance and polluted the city's water supply, with consequent increase in the typhoid fever death rate. To relieve this condition, in the early sixties, a part of the sewage-laden flow of the river was diverted into the Illinois and Michigan Canal and thence to the Illinois and Mississippi Rivers. Lack of funds at that time prevented lowering the bed of the summit level of the canal so it would divert the river when at a low level.

To remedy this condition, in 1870 a tunnel was built from the lake to a point on the North Branch of the Chicago River and pumps of large capacity were also installed at Bridgeport on the South Branch to lift the lake and river water to the Illinois and Michigan Canal.

Some of the city sewage reached the in-shore water intake constantly and a greater volume when the river was in flood. In 1864-67 the city built a tunnel under the lake, with an intake two miles out, at a point supposedly beyond pollution.

In 1871 the summit level of the Illinois and Michigan Canal was lowered, to increase its capacity for carrying sewage and water diverted from the Chicago River and diluted by fresh water from the lake.

In 1880 a tunnel 12 ft. in diameter was built from Lake Michigan along Fullerton Avenue to the North Branch of the Chicago River and reversible flow pumps with a normal capacity of 24,000 cu. ft. per min. were installed. Thereby a flow of water could be sent from the river

WORLD'S LARGEST—The 320 mgd South District Filtration Plant was Chicago's first

to the lake or from the lake into the river, according to the relative levels of the two bodies of water. In 1885 pumping to the lake was discontinued.

To relieve the South Branch of the river, pumps were installed in 1883 at Bridgeport, with a nominal capacity of 60,000 c.f.m., where the Illinois and Michigan Canal heads out from the South Branch.

City's First Water Tunnel

To provide more water for the rapidly growing city, taken from a point supposedly beyond sewage pollution, in 1887 construction of a water tunnel extending four miles into the lake was started.

By that time it had become evident that more effective means must be provided to protect the city water supply and to eliminate the intolerable nuisance from the river due to its overload of sewage. Impelled by the need for diverting all the sewage from Lake Michigan and by the increasing demand for a waterway from the Great Lakes to the Mississippi River, steps were taken that led to the construction of the Chicago Drainage Canal.

The Chicago Drainage Canal

Various committees were created, largely sponsored by the Citizens Association of Chicago; one, in 1880, to devise a plan to dispose of the sewage of the city without contaminating the city water supply; later, in 1886, a Drainage and Water Supply Commission, appointed by the City Council of Chicago. On August 27, 1885, another committee, including Lyman E. Cooley, an eminent hydraulic engineer, made a report stating that it was practicable to restore the ancient outlet of the Great Lakes by opening a channel across the Chicago Divide, thereby creating a waterway to the Gulf of Mexico. The most practicable route was from Lake Michigan through the Chicago and Des Plaines Rivers to the head of navigation on the Illinois River at Utica.

The Drainage and Water Supply Commission, appointed in 1886, was composed of Rudolf Hering of New York, Chief Engineer, and Benesette Williams and Samuel Artingstall, Consulting Engineers, of Chicago. Owing to lack of funds, no final report was made, but in a preliminary report made in January, 1887, the Commission stated that sewage farming as a means of disposal was impractical because it would require 10,000 to 15,000 acres of land, large conduits twenty miles long, and an immense pumping plant, with a lift of 90 ft. Instead, the Commission proposed what was, in effect, a continuation of disposal by dilution, which had been practiced imperfectly ever since the Chesbrough report of 1855, but improved later by diversion of the sewage and dilution by water from the lake.

Recommended Standards of Dilution

The great difference in the new proposed project was to divert enough water from the lake to prevent a nuisance. To that end, Hering, taking into account standards observed on trips abroad, proposed diversion of diluting water from the lake at a rate of 4 cu. ft. per second for each 1,000 of tributary population.

The original objectives of the Drainage Canal were:

(1) To protect the water supply of Chicago from pollution by its sewage; and

(2) To stop offense to eye and nose in the Chicago River and its branches, and later in the Calumet River.

Coupled with these objectives was the creation of a much larger navigable channel (24 foot depth) from Lake Michigan to the Mississippi River than was afforded by the Illinois and Michigan Canal (nominal 4 foot depth). In the minds of many of the strongest advocates of the Drainage Canal, navigation was paramount.

ENTRANCE—At doorway of Chicago's South District Filtration Plant. W. W. DeBerard, Deputy Commr. and Chief Water Engr.

The Sanitary District Established

To carry out the recommendations of the Hering Commission, the Illinois Legislature, on May 29, 1889, authorized, subject to a referendum vote, the creation of The Sanitary District of Chicago, with powers vested in a Board of Trustees, to divert water from Lake Michigan and reverse the flow of the Chicago River, with its burden of city sewage. The canal is twenty-eight miles long between the Chicago River and the Des Plaines River at Lockport. The minimum rate of diversion in the act was 3-1/3 cu. ft. per second per 1,000 population.

The time had arrived for drastic action. The stench arising from the Chicago River at low water created a nuisance which affected boats and the nearby streets and buildings. The greater menace was not so fully appreciated, namely, the gross pollution of the city water supply system when the river was in flood or when diversion of the sewage was interrupted. In the decade 1881-1890, the city averaged a typhoid death rate of 67.5 per 100,000 population. This was a very high rate compared with that of a few large American and many large European cities blessed with at least relatively pure water supplies. Chicago far surpassed its 1881-90 rate when, in 1891 its already high typhoid curve mounted to 174 deaths per 100,000 population. The epidemic extended into 1892, the typhoid deaths in January being greater than in any previous month since May, 1891.

Water Supply History

Briefly, the history of the Chicago Water System may be summarized as follows:

Chicago was incorporated as a Village on August 10, 1833, and as a City on March 4, 1837.

First public water service began in 1842.

City started construction of a distribution system in 1852.

City supplied by own water works system in Feb., 1854.

Water delivered from first crib intake and tunnel in March 25, 1867.

From 1867 on, the system developed to include, as of 1953:

6 intake cribs;
63.6 miles of water tunnels from 5 to 15 ft. diameter;
12 pumping stations;
The world's largest filter plant;
4016 miles of water mains from 4 to 54 inches in diameter;
43,954 fire hydrants
40,000 gate valves;
121,834 water meters.

In 1912 the City began to chlorinate in shore the lake water received from all cribs.

In 1926 an experimental filter plant was built on the South Side of the City.

On September 20, 1945, the South District filter plant went into service, with a nominal capacity of 320 mgd., serving 62 sq. mi.

In 1953 the pumpage of Chicago was, in gallons:

Daily average	1,006,654,000
Maximum day	1,470,220,000
Maximum hour	1,741,000,000
Daily average—Chicago	918,372,000
Daily average—Suburban	88,429,000

48.2% of the Chicago pumpage is metered, with 123,787 meters;
Non-metered (on assessed rate) services—335,697.

The per capita use was as follows:

Chicago	248 g.p.c.d.
Suburban (51 communities)	147 g.p.c.d.
Average	235 g.p.c.d.

Fifty-two municipalities are served outside Chicago in the adjacent suburban area, with a population of 1,500,000.

Construction of the North Side filter plant is planned shortly. This will be designed to supply 1,000 mgd.

The City has spent, to December 31, 1952, for water works plant a total of $235,095,224.

In 1953, the City supplied 4,298,000 people with water, estimated as follows:

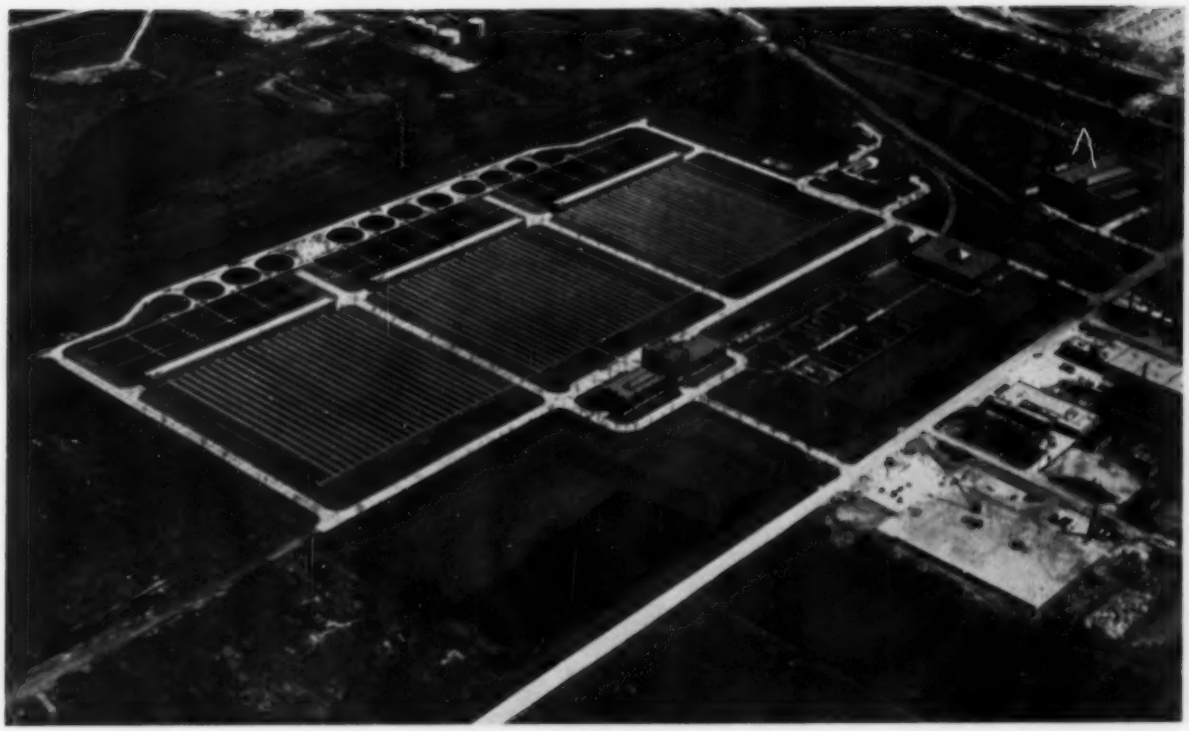
Chicago	3,700,000
in an area of 213 sq. mi.	
Suburban	598,000
in an area of 128 sq. mi.	
Total	4,298,000
in a total area of 341 sq. mi.	

Sanitation Accomplishments

What has been accomplished by all this expenditure?

In the first place, the sewage pollution from Chicago has been removed from its source of drinking water, with a marked reduction in the typhoid fever death rate. (In the 5-year period 1949-1953, the typhoid fever death rate averaged 0.012 per 100,000. This is a remarkable drop from 174 per 100,000 in 1891.) The shore of Cook County has been made safe for bathing. The sewage and industrial wastes of the Sanitary District have been treated to the highest practicable degree known to sanitary science, and the condition of the Illinois Waterway has been improved as far as practicable by treatment, so that for recreation, navigation, and fishing, it is fit from Marseilles to the river mouth.

When the City of Chicago has constructed its mammoth North Side filter plant, all the consumers will be furnished a safe, palatable, tasteless, and sparkling water, free from turbidity.



SEWAGE DISPOSAL—Chicago's North Side Treatment Works. These are activated sludge units

Under the terms of the Enabling Act of the Sanitary District, the City is required to furnish water at the City limits to those municipalities which are outside the City and do not border on Lake Michigan, at the same rate as charged to metered consumers inside the City.

Litigation

In the course of events it was inevitable that litigation ensue, as noted in chronological order.

The Drainage Canal was opened in January, 1900, without provision for sewage treatment. The planners relied solely on disposal by dilution of the sewage with water drawn from Lake Michigan.

Although the officials of the City of St. Louis must have known that construction of the Drainage Canal had begun early in 1892, it was not until late in 1898 that the Mayor appointed a commission to investigate "the plans proposed for the disposal of Chicago sewage" with regard to their effect on the water supply of St. Louis. The commission concluded in April, 1899, that the city water supply would be menaced by the discharge of the sewage of Chicago through the Drainage Canal and thence down the Des Plaines, Illinois, and Mississippi Rivers to and past the St. Louis water intake.

The Persistence of Pollution

On January 17, 1900, the State of Missouri, in an original case against the State of Illinois and The Sanitary District of Chicago, petitioned the United States Supreme Court to enjoin the discharge of the sewage of Chicago through the Drainage Canal and the Des Plaines and Illinois Rivers into the Mississippi. Never before in the history of sanitary litigation were so many expert witnesses—engineers, chemists, bacteriologists, and vital statisticians—employed in such a case.

Missouri attempted to prove that typhoid germs in the sewage of Chicago were carried 387 miles in the Illinois Waterway system to enter the Mississippi River and pollute the water supply of St. Louis. Justice Holmes rendered the decision of the United States Supreme Court on February 19, 1906, stating—

> "Both sides agree that the detection of the typhoid bacillus in the water is not to be expected. But the plaintiff relies upon proof that such bacilli are discharged into the Chicago sewage in considerable quantities; that the number of bacilli in the water of the Illinois is much increased, including the bacilli coli communis, which is admitted to be an index of contamination and that the chemical analysis lead to the same inference. To prove that the typhoid bacillus could make the journey, an experiment was tried with the Bacillus Prodigiosus, which seems to have been unknown, or nearly unknown, in these wastes. After preliminary trials, in which these bacilli emptied into the Mississippi River near the mouth of Illinois were found near St. Louis intake and in St. Louis in times varying from three days to a month, 107 barrels of the same, said to contain one thousand million bacilli to the cubic centimeter, were put into the Drainage Canal near the starting point on November 6, and on December 4 an example was found at the St. Louis intake. Four others were found on the three following days, two at the tower and two at the mouth of the Illinois."

The Court further cited experiments with typhoid fever germs by Illinois which indicated that the duration of the life of the germs was much exaggerated and might not exceed three or four days.

The case was dismissed by the Court without prejudice, and has never been reopened. As a matter of fact, the City of St. Louis found that the water from the Illinois River did not affect its source of water supply from the Mississippi River, and later constructed water purification works to remove the turbidity from the river water.

WEST-SOUTHWEST WORKS—The activated sludge plant is in middle; West Side Imhoff Plant is in upper right

Legal Right to Diversion

The next question which arose after the canal was opened was as to the legal right to divert water from Lake Michigan. The original permit on May 8, 1889, from the Secretary of War was based on preserving navigation in the Chicago River and was restricted on April 9, 1901, to 3,333 c.f.s. Later modifications limited the flow to 4,167 c.f.s. after March 31, 1903.

Subsequent requests for a flow of 10,000 c.f.s. were denied and suits brought by the Secretary of War in 1908 and 1912 to enjoin the enlargement of the diversion. These were consolidated and on June 18, 1923, the Court entered a formal decree finding in favor of the Federal Government. On appeal, the U. S. Supreme Court confirmed the lower Court, on January 5, 1925.

In the meantime, the requirements of modern sanitation had been investigated by the Sanitary District, as well as the methods of sewage treatment available. The original plan was to divert water to dilute raw sewage with 3-1/3 c.f.s. per 1,000 population. By 1909, when Col. R. R. McCormick was President of the Board of Trustees, it became evident to the late George M. Wisner (then Chief Engineer), that means of supplementing dilution by treatment must be found.

Testing stations were built by the Sanitary District to study domestic sewage, packinghouse waste, tannery waste, and corn products waste.

Construction of Treatment Works

In 1921, an amendment to the Sanitary District Act ordered the Sanitary District to construct treatment works to handle an annual increment of 300,000 people, until about 1,800,000 persons had been cared for. A treatment program was adopted in 1924.

Meanwhile, the aroused opposition by the Lake States to the diversion at Chicago culminated in an original suit before the U. S. Supreme Court, brought in 1922, amended in 1925, and further suits in 1926. The Court handed down a decree on April 19, 1930, whereby the diversion was to be reduced to 1,500 c.f.s. on December 31, 1938 (Hon. Charles E. Hughes, Master).

The depression of 1931 and financial difficulties of the Sanitary District retarded its construction program, so that the final cut in diversion in 1938 created a nuisance in the Joliet pool, although the condition of the Illinois River from Morris to Peoria was improved by the increased time of flow.

For engineering purposes, the Sanitary District area is divided into five general projects; the North Side, West Side, Southwest, Des Plaines River, and Calumet. Since 1931, the Des Plaines River area has been sewered into the West Side Works. At the end of 1953, four major sewage treatment works were in operation, with a combined capacity of 1,286 m.g.d.

Since December, 1949, practically all the sewage has been given activated sludge treatment. In 1953 this totaled a flow of 1,104 m.g.d. The total B.O.D. in the effluents averaged 126,700 lb. per day, indicating a removal of practically 90%.

Plant Design Characteristics

The design of the sewage treatment works was gradually developed from an experimental plant at Maywood, built in 1921. The North Side Works was planned prior to 1924 and went into operation in the fall of 1928. This plant was designed to demonstrate that a sewage works could be ornamental as well as useful. It proved more efficient than was expected, in that a suitable effluent was established with a 4-hour aeration period and a use of air ranging from 0.36 to 0.49 cu. ft. per gal., using 476 to 717 cu. ft. of air per lb. of B.O.D. The annual average removal of B.O.D. reached 94.9 per cent in 1947 and declined to 93 per cent in 1953. With the addition of some final

WEST-SOUTHWEST LAGOONS—See text for the story of growth in sewage disposal facilities

settling basins in 1936, the nominal capacity of the plant was increased from 180 to 250 m.g.d.

Considerable attention has been given to the design of the aeration tanks in the Calumet and Southwest Works. The flow type of aeration was justified and the need of clean air demonstrated. Diffuser plates used recently have a higher porosity than in 1928.

The general type of layout originally adopted has been consistently followed, with a concentration of operating stations and reduction in number of recording meters.

The mechanization of the sewage treatment works is of interest.

The North Side Works (built in 1923-1928) contains 370 electric motors, totaling 21,000 H.P. This plant is completely electrified. The Calumet Works (built in 1931-1935) is also completely electrified, containing 210 electric motors, totaling 12,500 H.P. The West-Southwest Works, recently completed, contains over 1,440 electric motors, totaling 19,841 H.P. However, the larger units in this plant, such as sewage pumps, air compressors, and electric generators, are driven by steam turbines.

Handling of Sewage Sludge

Sludge handling operations are concentrated at the West-Southwest Works and at the Calumet Works. The total dry solids received at the four major works in 1953 were 741.5 tons per day, including 54.3 tons at Calumet. Of the total solids, 628.2 tons were removed daily.

At Calumet, about one-half the tonnage received is heat-dried and sold, the balance being lagooned.

At the West-Southwest Works, in 1949, the excess activated sludge is heat-dried, according to the working capacity of the equipment and the available supply of coal. From 200 to 500 tons of dry sludge are produced daily. During the development period, the preliminary sludge and surplus activated sludge were pumped to lagoons about five miles away.

At the West Side Works, the Imhoff tanks digest the solids which are deposited from the West Side sewage (in 1953, some 204 tons per day). Some 616,424 cu. yd. of wet sludge were drawn in 1953 and deposited on 27.3 acres of drying beds, from which some 146,297 cu. yd. of air-dried material were removed, containing 65.8 per cent moisture. These beds are cleaned by unique mechanical strippers. The solids as stripped are deposited in standard gage 30 cu. yd. dumping cars, and run out to a dump some three miles away. The plant effluent is mixed with the raw sewage from the Southwest area and treated by the activated sludge process.

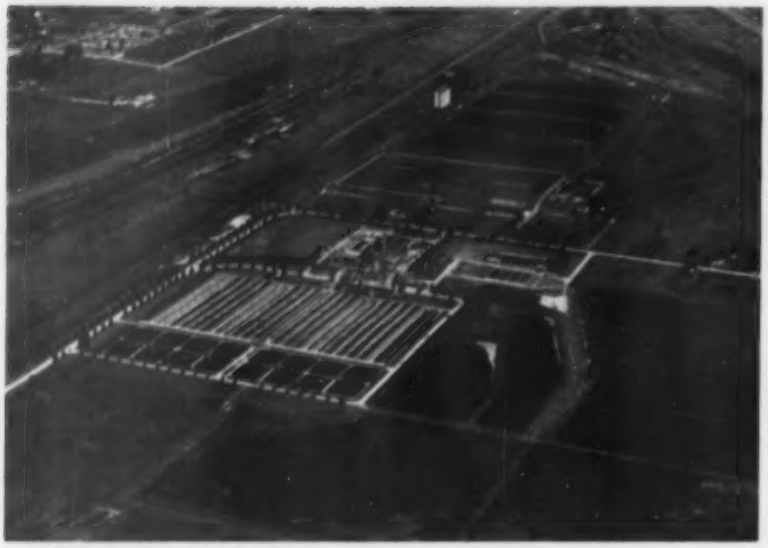
The lagoons provide a capacity of 110,000,000 cu. ft. and occupy 183 acres in a site of 265 acres. Between November, 1943, and July, 1950, about 567,662 tons of dry solids were deposited, of which 345,000 tons were placed in the original 50,000,000 cu. ft., or about 14 lb. per cu. ft. These original lagoons are practically filled up.

Dewatering and Drying Sludge

Vacuum filters were first used by the Sanitary District around 1922, with sulfate of alumina as a sludge conditioner. In 1923, Dr. F. W. Mohlman and John R. Palmer discovered the value of ferric chloride.

In the early days the filter cake was heat-dried in a rotary drier. In 1931-1936, an intensive study of mechanical dewatering, heat-drying, and incineration was carried on by W. A. Dundas and Philip Harrington, which clarified the problem and developed the procedure now known as flash-drying. This was installed as a pilot plant at the Calumet Works in June, 1936. At the Southwest Works, a larger installation went into service on August 7, 1939.

The commercial sale of heat-dried sludge began on October 12, 1939. The output has varied from year to year, rising to 92,000 tons in 1953. The material is sold in carload lots containing less than 5 per cent mois-



CALUMET WORKS—Another sewage treatment plant in Chicago's disposal system

ture, with an approximate content of 6.1 per cent ammonia and 3 per cent phosphorous (APA). The selling price per ton reached a peak of $25.25 in 1947, and has since declined to around $15.00.

However, the cost of coal per ton has risen from $3.10 in 1939 to $5.50 currently. The cost of ferric chloride rose per ton from around $30.00 in 1940-1945 to $88.40 in 1948, and $85.06 in 1949. For the last ten years, the use of ferric chloride has averaged 8.53 per cent at the Southwest and 6.36 per cent at Calumet.

Sanitary District Cost Data

Prior to December 31, 1953, the Sanitary District had expended approximately $305,000,000 in sewers, sewage treatment works, and pumping stations. This was in addition to $92,000,000 expended on the drainage canal, its tributaries, and adjuncts. The gross cost of maintenance and operation has risen from $4,581,815 in 1941 to $8,244,314 in 1949; the net cost from $4,103,930 in 1941 to $7,266,483 in 1949.

Since 1938, the annual average content of B.O.D. in the plant effluents has declined from 598,800 to 126,700 lb. per day, in 1953, and in the discharge at Lockport, from 685,000 to 113,000 lb. per day. In the summer months of 1953, the discharge at Lockport contained 108,200 lb. of B.O.D.

The Illinois Waterway extends from Lake Michigan to the Mississippi River, a distance of 327.2 miles. Since 1938, the annual average discharge, through 1953, at Lockport has been approximately 3,380 c.f.s., of which approximately 1,650 c.f.s. is sewage flow or effluent.

Nuisance Problems Remain

The Illinois Waterway may be divided into two parts, one above Peoria; the other, below. The critical part of the upper portion is from Lockport to the Kankakee River. Since 1938, the condition of the Illinois Waterway from the Kankakee River to Peoria has been good.

The indications are that a standard of 4 p.p.m. of dissolved oxygen cannot be met between Lockport and the Kankakee River with a diversion of 1,500 c.f.s. It has been met from Marseilles to Peoria in the past twelve years. Apparently fish have been working up the Illinois River for the past twelve years and are now found in the vicinity of Marseilles.

One of the difficulties of the fish situation in the Illinois River area has been the destruction of breeding places by the reclamation of backwater sloughs and pools, by levees, and for agricultural use.

Another problem which arises is the possible effect of the content of nitrogen and phosphorus in the waterway in stimulating plant growth to a luxurious basis and consequent development of a secondary nuisance in the Illinois Waterway. At present the discharge at Lockport contains about 57 tons of nitrogen daily, or an average of about 6 or 7 p.p.m. of nitrogen. So far as is known, this is the highest content of nitrogen of record for a stream in the United States.

As yet there is no way known of removing economically the nitrogen or phosphorus from sewage effluents. There seems to be a possibility that dilution will be helpful.

Subsequent Litigation Experience

At the time the diversion was cut on December 31, 1938 to 1,500 c.f.s., the sewage treatment works were inadequate to reduce the pollution load to an amount sufficiently low to maintain existing conditions in the upper Illinois Waterway as theretofore existed. As a result, a very odorous nuisance developed in the Joliet pool, which prompted the State of Illinois to request the U. S. Supreme Court for a temporary increase in the diversion from Lake Michigan.

Hearings were held before a Special Master, Monte M. Lemann, of New Orleans, La., in 1940-1941, who held that no menace to health was proved and that no remedial measures were available, as effective or as promptly as the proposed completion of the sewage treatment works of The Sanitary District of Chicago. The U. S. Supreme Court denied the petition.

Although along the Illinois shore of Lake Michigan, The Sanitary District of Chicago has removed practically all the pollution from Lake Michigan, except that from shipping, the smaller North Shore Sanitary District (1950 population 99,090) still discharges chlorinated effluent from a number of primary treatment plants.

A considerable amount of pollution was discharged from industries and to some degree by municipalities in Northern Indiana, which was windblown in surface currents towards the Southerly Chicago intakes. As amicable attempts failed to clean up the pollution, in 1943, the State of Illinois brought suit in the United States Supreme Court (No. 11 Original) against the State of Indiana, the City of Hammond, the City of East Chicago, the City of Gary, and the City of Whiting to restrain the State and its agencies (including twenty industrial establishments) from polluting Lake Michigan, the source of drinking water for Chicago and the surrounding territory in Northern Indiana and Illinois. The Court appointed a Special Master, Luther E. Smith, of St. Louis, Mo.

The case is somewhat unique in that, although no testimony was taken, much has been accomplished. The total cost of the improvements required amounted to about $15,000,000, chiefly for removing industrial wastes. The largest single expenditure was by the Standard Oil Company of Indiana, in the amount of

Populations and Areas
City of Chicago and The Sanitary District of Chicago

Year	Census Population	Area (Sq. Mi.)
	City of Chicago	
1840	4,479	10.86
1850	29,963	13.50
1860	109,206	23.709 ('63)
1870	306,605	43.308
1880	503,185	
1890	1,099,850	170.46
1900	1,698,575	189.52
1910	2,185,283	190.2
1920	2,701,705	198.27
1930	3,376,438	207.20
1940	3,396,808	212.86
1950	3,620,962	212.93
	The Sanitary District of Chicago	
1890	1,114,000	185
1900	1,638,655	185
1910	2,308,276	358.1
1920	2,986,000	395.51
1930	3,901,569	442.35
1940	3,962,514	442.85
1950	4,338,958	470.18

$6,000,000 for oil separators, and for collecting the sanitary sewage in its plant and delivering it to the sewers of Whiting for treatment by Hammond. The only municipal work required cost $90,000 for revising sewers in Whiting. The program was completed on November 6, 1950. Even with the great reduction in pollution, the residual oil wastes still cause the City of Chicago to use a considerable excess of activated carbon in controlling tastes at the South Side filter plant at certain seasons of the year.

The final chapter on diversion of lake water has yet to be written. On August 20, 1954, Congress passed a bill authorizing an increase to 2,500 c.f.s. for the diversion. This was vetoed by President Eisenhower on September 3, 1954, so the diversion stands at 1,500 c.f.s., despite the fact that the Supreme Court apparently has always been of the opinion that the control of the diversion rests in Congress.

The additional diversion would have been helpful in counteracting the growth of algae due to the presence of nitrogen and phosphorus in the discharge at Lockport.

Bibliography

Chicago Sewerage

Chesbrough Report of 1855, Engineering News, pp. 42, 55, 79, April 15 to June 15, 1875.

"Report of the Results of Examinations Made in Relation to Sewerage in Several European Cities in the Winter of 1856-1857" by E. S. Chesbrough (1858).

"The Lakes to the Gulf Waterway as Related to the Chicago Sanitary Problem," L. E. Cooley, C. E., Chicago (1888).

"Typhoid Fever in Chicago," W. T. Sedgwick and Allen Hazen, Engineering News, Vol. 27, pp. 399-402.

"Sewage Disposal in the United States," G. W. Rafter and M. N. Baker (1894).

"Discovery and Conquests of the Northwest, with the History of Chicago," Rufus Blanchard, 2 Vols. (1898).

"Drainage Channel and Waterway," G. P. Brown (1894).

M. N. Baker—unpublished notes.

"Pollution of Illinois and Mississippi Rivers by Chicago Sewage," M. O. Leighton; Water Supply and Irrigation Paper No. 194, U. S. Geological Survey (1907), a digest of the testimony taken in the Cast of Missouri v. the State of Illinois and The Sanitary District of Chicago.

"Illinois Water Litigation, 1940-1941," by Langdon Pearse, Transactions, American Society of Civil Engineers, Paper No. 2221, pp. 799-836 (1942).

Chicago Water Supply

"A Report on the Water and Sewerage Systems of the City of Chicago, with Comparative Study of Certain Other American Cities," The Civic Federation, Chicago, Ill. (1950-1952).

"Expansion of the Chicago, Ill. Water Supply," by W. W. Berard; Transactions, American Society of Civil Engineers, Paper No. 2612; Centennial Transactions, Vol. CT (1953), pp. 588-603.

Annual Report, Department of Water & Sewers, 1951, City of Chicago.

Los Angeles Water Projects Planned to Meet Growth

An $80,238,000 construction program now under way will provide ample water and electric service for the influx of people and industries expected to locate in Los Angeles in 1955. Already rated as the outstanding American city in water reserves for future needs, the Los Angeles system is continuing to enlarge and extend its pipelines, reservoirs and other facilities.

Two records established in 1954 indicate the rapid growth of the local water system. With the installation of the 500,000th water meter, Los Angeles became the first city in the U. S. to hit that high mark for registering water use by consumers. And, the fiscal year period ending last June 30 saw the completion of more reservoir projects than during any comparable period in the 52-year history of the Department of Water and Power.

The major water project is a ten-mile pipe line linking Eagle Rock and Hollywood reservoirs. To be completed in 1955, this will carry 171,000,000 gallons of water daily. It provides the city's most important connection to the Colorado River supply, brought here by the Metropolitan Water District over a distance of 300 miles. Cost of the new line is $6,400,000.

Present plans of the city's Department of Water and Power call for an investment of $335,000,000 for improvements and expansions during the next five years, according to general manager S. B. Morris.

Wieters and Harris Get New USPHS Assignments

Recent reassignments in top water pollution control staff personnel of the U. S. Public Health Service include appointment of Alfred H. Wieters, former Assistant Chief, Water Pollution Control Program, as a consultant to the Brazilian Ministry of Health, where he will advise on legislative, technical and administrative problems in a national water pollution control program. He had been in his present position at Washington, D. C., since 1947.

Also reassigned is Robert R. Harris, chief of the USPHS Water Pollution Control Basin Office in Portland, Ore., who now becomes Chief, Water Supply Branch, Division of Sanitary Services, Washington, D. C.

A. W. W. A. Technical Program

75th Annual Convention, Chicago, Ill., June 12 to 17, 1955

THE FOLLOWING PROGRAM lists the technical sessions of the forthcoming 75th Annual Convention of the American Water Works Assn. According to Secretary Jordan, minor changes may be made in this advance program. All meetings and exhibits are to be held in the Conrad Hilton Hotel.

AWWA 1955 CHICAGO CONFERENCE
TECHNICAL PROGRAM

Monday—June 13—A.M.

(1) Joint Boiler Feedwater Research Committee

Merits, Defects and Performance of Mono-bed and Two-bed Demineralizing Systems.....H. E. Bacon, L. G. VonLossberg, S. T. Powell

Boiler Water Suspended Solids—Their Significance, Identification and Control.....S. K. Adkins, B. J. Wachter

Corrosion Problems in Small Heating Boilers.....H. F. Hinst

Monday—June 13—A.M.

(2) Open Session

Water Works Administration Committee

Monday—June 13—P.M.

(3) Water Purification Division

Effect of Various Types of Water on Non-Ferrous Metals.....Lee Streicher

Problems in Estimating Fluorides in Water.....H. P. Kramer

Biological Infestation of Purified Water.....Panel Discussion
Moderator.....M. P. Crabill

Effect of Disinfection Dosages of Chlorine on New Water Mains.....William Yegen

Monday—June 13—P.M.

(4) Water Resources Division

Regional Water Supply Planning for North Central Ohio.....Paul Belcher
Discussion.....Wendell R. LaDue

Our National Water Resources Policy.....Clarence A. Davis

1955 State Legislation Concerning Water Resources
A Panel Review.....A. P. Black, Moderator
Area Representatives:

North Atlantic	Missouri Valley
South Atlantic	Southwest
Ohio Valley	Pacific Coast

Tuesday—June 14—A.M.

(5) Water Resources Division

Development of a Fresh Water Barrier in Southern California.....Finley B. Laverty

Recharge Operations of the Upjohn Company at Kalamazoo.....W. H. Sisson

Streams Plus Wells Make Economical Industrial Supply.....R. D. Wilson
Discussion.....Clifford Fore

Tuesday—June 14—A.M.

(6) Water Purification Division

Unique Features in Water Treatment Plant Design.....H. O. Hartung, Moderator
Panel Discussion

William Aultman	Marshall Houghn
C. M. Beck	Thomas M. Riddick

Recording Instrumentation in Water Treatment Plants.....Oscar Gullans

Effects of Detergents on Water Treatment.....J. C. Vaughn
Discussion.....Charles D. Gates

Tuesday—June 14—A.M.

(7) Distribution Division

Business Session

Tuesday—June 14—P.M.

(8) Water Purification Division

The Magnitude and Treatment of Nuclear Reactor Wastes.....W. A. Rodger

General Review—Studies of Water Treatment Methods to Reduce Radioactive Pollution to Tolerable Levels.....Gladys Swope

Instrumentation for Radioactive Pollution Studies.....H. E. Pearson

1955 Studies of Radioactive Fallout.....Rolf Eliassen

Tuesday—June 14—P.M.

(9) Water Resources Division

Symposium—Controlled Draft from Reservoirs
New York Metropolitan System.....Edward Clark
Philadelphia Suburban.....George Dann
Johnstown Plant—Bethlehem Steel.....Angus Henderson
Equating Surface and Underground Storage.....A. S. Toth, R. A. Hill

Water Management—Another Necessity in Modern Industry.....K. S. Watson

Tuesday—June 14—P.M.

(10) Management Division

Business Session

Wednesday—June 15—A.M.

(11) Management Division

The Problem of the Suburbs and Public Services Introduction.....Abel Wolman

The Federal Housing Administration's Concern.....John C. Hazeltine

The Public Service Commission's Viewpoint.....O. P. Deuel

The State Sanitary Engineer's Viewpoint.....W. F. Shephard

The Fire Protection Problem.....Kenneth Carl
Discussion
Résumé.....Abel Wolman

Wednesday—June 15—A.M.

(12) Distribution Division

Design of Cement Lined Steel Pipe.....E. S. Cole

Electrical Inspection of Coatings on Steel Pipe.....Mark Davidson

New Developments in Tests of Coatings and Wrappings.....G. E. Burnett

Wednesday—June 15—A.M.

(13) Water Resources Division

Business Session

Wednesday—June 15—P.M.

(14) Research Projects/Progress and Planning

Effects of Physical Environment on Water Mains.....W. D. Hurst, R. F. Legget, A. Baracos

Chromium and Cadmium in Water.....Clarence F. Decker
Effect of Water Treatment on Water Mains.....A. M. Buswell
Public Health Service Research Grants in the Area of Environmental Health/Water Supply.....Irving Gerring
Report of AWWA Committee on Water Works Research Needs.....Martin E. Flentje

Wednesday—June 15—P.M.

(15) Management Division

Electrical Reliability Requirements for the Water Plant.....E. O. Potthoff
Maintaining Electrical Controls at High Efficiency.....J. P. Kesler
Modernizing Chicago's Pumping Stations.....O. B. Carlisle, J. L. Weeks
Progress in Tunnel Construction for Central District Filtration Plant.....George S. Salter

Thursday—June 16—A.M.

(16) Water Purification Division

Business Session

Task Group Reports

R. L. Derby — Max Levine
James E. Kerslake — J. B. Miller
L. L. Hedgepeth — J. C. Zufelt

Thursday—June 16—A.M.

(17) Management Division

A Forecast of Metropolitan Chicago's Water Needs.....L. R. Howson
Water Supply Industry Safety—U. S. Labor Department Survey.....Geo. R. McCormack
A Successful Safety Program.....J. W. McFarland
Discussion.....Thomas Allen
Modernizing the Management of Chicago's Water Department.....J. W. Jardine

Thursday—June 16—A.M.

(18) Distribution Division

Easements for Pipelines.....Burton S. Grant
Pumping Stations in Residential Areas
Long Island.....D. J. Hennessy
California.....L. A. Hosegood
The Solution Effects of Water Upon Cement/Concrete Linings of Water Mains.....M. E. Flentje, R. J. Sweitzer
Discussion.....P. S. Wilson
A 15 Year Exposure Test on Three Types of Distribution Pipe.....M. J. Shelton

Thursday—June 16—P.M.

(19) Management Division

Ready-to-serve Charges for Private Fire Protection.....L. R. Hanson
Service Charges for Air Conditioning.....W. V. Weir
The Lawn Sprinkling Load—Panel Discussion.....Angus Henderson, E. F. Tanghe, L. S. Finch, M. P. Hatcher
Getting Your Customers on Your Team.....Joseph S. Rosapepe

Thursday—June 16—P.M.

(20) Open Session

Water Works Practice Committee

Ninety-Two Exhibitors at Chicago Convention

Exhibition space will be provided for 92 exhibitors at the seventy-fifth annual convention of the American Water Works Association to be held in Chicago, Ill., June 12-17 in the South Exhibition Hall of the Conrad Hilton Hotel.

According to the Water and Sewage Works Manufacturers Association, the list includes:

American Cast Iron Pipe Company
American City Magazine
American Well Works
AquaMatic
Armco Drainage and Metal Products
Badger Meter Manufacturing Company
Baker and Company, R. H.
Barrett Division
B-I-F Industries
Bingham and Taylor Corporation
Buffalo Meter Company
Burroughs Corporation
Calgon
Centriline Corporation
Chicago Bridge and Iron Company
Chicago Pump Company
Clow and Sons, James B.
Culligan, Inc.
Darling Valve and Manufacturing Co.
De Laval Steam Turbine Company
Dorr-Oliver
Dresser Manufacturing Division
Electro Rust-Proofing Corporation
Engineering News-Record
Everson Manufacturing Company
Fairbanks Morse & Co.
Filtration Equipment Corporation
Fischer and Porter Company
Ford Meter Box Company
Foster Engineering Company
Foxboro Company
General Filter Company
Glamorgan Pipe and Foundry Company
Golden-Anderson Valve Specialty Co.
Graver Water Conditioning Company
Hanks Company, Fred W.
Harco Corporation
Hays Manufacturing Company
Hersey Manufacturing Company
Homelite Corporation
Industrial Chemical Sales Division
Inertol Company
Infilco
Johns-Manville
Johnson, Edward E.
Keasbey and Mattison Company
Kennedy Valve Manufacturing Company
Koppers Company
Layne and Bowler
Leopold Company, F. B.
Link-Belt Company
Lock Joint Pipe Company
McWane Cast Iron Pipe Company
M and H Valve and Fittings Company
Mueller Company
National Water Main Cleaning Company
Neptune Meter Company
Pelton Water Wheel Company
Permutit Company
Pitometer Associates
Pittsburgh-Des Moines Steel Company
Pollard Company, Joseph G.
Pratt Company, Henry
Preload Company
Price Brothers Company
Public Works
Rensselaer Valve Company
Roberts Filter Manufacturing Company
Rockwell Manufacturing Company
Ross Valve Manufacturing Company
Sherman Products
Simplex Valve and Meter Company
Skinner Company, M. B.
Smith Manufacturing Company, A. P.
Smith-Blair
Smith Company, S. Morgan
Sparkler Manufacturing Company
Sparling Meter Company
Stuart Corporation
Traverse City Iron Works
United States Pipe and Foundry Co.
Vogt Mfg. Co.
Wachs Company, E. H.
Walker Process Equipment
Wallace and Tiernan
Water and Sewage Works
Water Works Engineering
Well Machinery and Supply Company
Welsbach Corporation
Westinghouse Electric Corporation
Wood Company, R. D.
Worthington-Gamon Meter Division

Water Service and What It Costs

2—A Completely Adequate Source of Supply

by FRANCIS S. FRIEL

Mr. Friel is President, Albright & Friel, Inc., Consulting Engineers, Philadelphia, Pa. **In this paper he summarizes certain problems involved in developing surface and underground sources of water supply. He discusses in some detail approximate construction costs, but emphasizes that each water supply undertaking is a problem in itself.**

A Symposium of Papers on Water Service and What It Costs

Mr. Friel's is the second of four papers comprising a symposium on "Water Service and What It Costs" presented at the Annual Meeting of the Pennsylvania Water Works Association in Atlantic City, N. J., in October, 1954. The first paper, by Abel Wolman, was published in our March issue. Two remaining papers, listed below, will shortly be published in WATER & SEWAGE WORKS.

3. **Completely Adequate Water Treatment**
4. **A Completely Adequate Distribution System**

THIS discussion will summarize problems relating to the development of satisfactory sources of water supply, both surface and underground, and will then discuss approximate construction costs of developing the two types of supplies. It must be borne in mind that each water supply undertaking is a problem in itself—and that no definite yardstick can be set up which will accurately estimate the cost of all types of water supplies.

The unit cost of developing a water supply from a large river, such as the Delaware, is considerably less than that for developing a supply from an inland stream where it is necessary to construct a dam and an impounding reservoir. The cost per gallon of developed water yield of an underground source is less in an area where the subsurface is sand, such as areas in New Jersey, than it is in a rock formation which is usually encountered in most parts of Pennsylvania. Other factors which bear upon the cost of a completely adequate and satisfactory source of water supply are the distance of the supply from the filter plant or distribution system, and also whether the water requires pumping or flows to the point of usage by gravity. Therefore, the estimated costs which are presented in this discussion should be used with caution.

In the development of these cost data, a completely adequate and satisfactory source of supply has been considered as one which will produce water of proper quality in satisfactory quantities for both domestic and industrial purposes. The water must be potable or capable of being made potable by treatment. The municipality or industry which can obtain a potable supply from surface waters without treatment, other than chlorination, is rare and fortunate indeed.

Planning for Future Growth

An adequate supply must provide for the future growth of both population and industry. Where new supplies are being considered, the projected demands on the system should be estimated for a period of at least 25 years in the future—and future forecasts should be reviewed from time to time, possibly each year. It is prudent to overestimate demands rather than to underestimate, especially where it is economically feasible to provide for surface water which will make possible industrial growth and increased domestic usage.

Past experience indicates that many supplies are inadequate. L. D. Matter reported[1] that during 1953, 56 public water supplies in Pennsylvania were dangerously low; as a result, restrictions were placed upon the use of water for such purposes as car washing and lawn sprinkling. Of these 56 supplies, 21 found it necessary to obtain water from auxiliary or emergency sources continuously through the 1953 dry period and until April, 1954. The communities which were affected ranged in population from 500 to 80,000. The cause of these water shortages was the increased water demand coupled with the dry season and subsequent low stream flows.

C. G. Paulsen[2], in discussing the report of the U. S. Geological Survey on "Public Water Supply Shortages—1953" has presented statistics on the number of water shortages due to drought and supply failures or other causes, as 1,072, or 6.2 per cent of all systems reporting.[3] The data in Table 1 are from this report.

Increased Demands Cause Shortages

It is of interest to note that 38 per cent of the systems serving over 100,000 population were faced with water shortages; and that 30 per cent of the systems serving populations between 50,000 and 100,000 persons had the same experience. It is further significant that 51 per cent of the 1,072 cases of water shortage were caused by population growth and increased seasonal use.

There has been a sharp rise in the use of water not only in Pennsylvania, but all over the country—and failures in certain water supply systems have been inevitable because of the great demands made upon them. These failures are accentuated in seasons when droughts are widespread, such as occurred in the Summer of 1953, and which have continued to the present.

TABLE 1

Public Water Supply Shortages—1953

Population Group	No. of Systems Reported	No. of Shortages	Systems Experiencing a Shortage
Less than 1,000	8,433	349	4.1%
1,000 to 5,000	6,047	371	6.2%
5,000 to 10,000	1,126	130	12.0%
10,000 to 25,000	719	86	12.0%
25,000 to 50,000	221	34	15.0%
50,000 to 100,000	108	32	30.0%
More than 100,000	93	35	38.0%
Population unknown		35	
TOTAL	16,747	1,072	6.4%

This discussion of water shortages has a direct bearing upon the cost of a fully adequate and satisfactory source of water supply, because it is necessary to consider the basic elements of design which contribute to failures, and which should be provided for in an adequate system. The reconnaissance by the U. S. Geological Survey, of the 1,072 systems which reported water shortages, revealed that a water supply was assumed to have a shortage when it was unable to supply its customers' peak demands and was compelled to restrict the use of water.

Another example: early in 1953, *Public Works Magazine*[4] made a questionnaire survey of water works supplying a population of more than 3,000. This survey revealed that these shortages were grouped into:

(a) Those due to an inadequate water supply,

(b) Those due to inadequate treatment facilities, and

(c) Those due to inadequate distribution facilities. Fifty-five per cent of the shortages as reported by this survey were attributed to demands exceeding water supply.

Generally speaking, about 6 per cent of all public water supply systems in the United States, serving about 24-million customers, restricted the use of water in 1953. For all shortages reported, the predominant reason was due to inadequate water supply, increased population and seasonal variation and use. Of the 1,072 shortages reported to the U. S. Geological Survey, drought or failure of the water supply alone counted for 367 and contributed to an additional 116.

It is pertinent to this discussion to note that water withdrawn from surface supplies in Pennsylvania in 1951[5] for public supply purposes was 1.2 billion gallons per day, while that taken from sub-surface supplies was 112-million gallons per day. More than 90 per cent of the water used in Pennsylvania for public supply purposes is surface water and less than 10 per cent is from underground sources. The cost data presented in this paper will, therefore, dwell upon the cost of developing a fully adequate and satisfactory surface supply, and will bear only slightly upon the cost of an underground source.

Surface Water Supply Sources

A surface water supply is obtained by collecting and storing the runoff resulting from rainfall. The runoff will vary greatly from State to State, and for locations within a State. Since the water used comes as rainfall, we must look into rainfall and runoff records for information to use in the design of a surface water supply.

Climatological data published by the U. S. Weather Bureau, and water supply papers published by the U. S. Geological Survey, together with information assembled by State agencies (such as the Pennsylvania Department of Forests and Waters) are most important to the design of a surface water supply. The rainfall at different points in the area under consideration is derived from standard rainfall gauges supplied with the climatological data.

Gail A. Hathaway, Assistant to the Chief of Engineers, U. S. Department of Defense,[6] has stated: "The average annual precipitation in the United States is about 30 inches, of which 70 per cent returns to the atmosphere by evaporation or by transpiration from growing vegetation. This leaves a water yield of about 8.5 inches.

"This yield is available in our streams and through wells tapping underground storage areas, but is not distributed uniformly over the United States. In fact, some of our greatest problems are due to maldistribution of water supply, both as to time and geographic areas. For example, 17 western states constitute about 60 per cent of the land area but receive only 25 per cent of the nation's water supply. The runoff for these 17 western states averages less than 4 inches. On the other hand, the runoff for 31 of our eastern states averages about 16 inches."

In Pennsylvania we are fortunate because our average rainfall is approximately 42 to 46 inches per year, and the runoff will vary between 17 and 22 inches per year. The rainfall and runoff will vary in different sections of the State, and the runoff will likewise vary with the character of the watershed. The flow in many streams run below 0.25 cu. ft. per second per square mile, while during maximum flood periods the flow in a stream might increase as much as 200 times the minimum. This condition exists in the Delaware River. The problem, therefore, is—*at times too little, and at times too much.*

TABLE 2

Yield vs. Storage Required

Water Supply Yield In Gallons Per Day Per Square Mile	Storage Capacity Required in Million Gallons Per Sq. Miles
200,000 gallons	15,000,000
300,000 gallons	30,000,000
400,000 gallons	50,000,000
500,000 gallons	70,000,000
600,000 gallons	90,000,000
700,000 gallons	125,000,000
800,000 gallons	160,000,000

The question is "How much water shall we provide in a completely adequate and satisfactory source of supply?" The answer to this question is that it should be adequate within economical limits to supply the peak demands. Generally speaking, the average rate of water consumption will be approximately as follows:

(a) The average water consumption will be approximately 100 gallons per capita per day. This includes moderate industrial usage.

(b) The consumption on a maximum day will be twice that of the average day.

(c) The maximum rate of consumption for a 3-hour period will be approximately 3.5 times the average daily rate.

(d) The maximum rate of consumption for a 1-hour period will be approximately 4-times the average daily rate.

From personal experience in a municipality with a population of over 40,000 persons, the following results were observed on July 13, 1954, during a peak day period:

(a) The average water consumption is considered as 100 per cent.

(b) The consumption on the maximum day was 157 per cent of the average.

(c) The maximum 3-hour consumption was 382 per cent of the average.

(d) The maximum hourly consumption was 520 per cent of the average.

Another example during the 1954 dry Summer period, in a municipal water plant serving some 16,000 persons, can be reported. The maximum hourly demand was at the rate of 6 million gallons per day, as compared

to an average daily demand of 1.5 million gallons per day.

These maximum daily demands do not affect a surface supply as much as they do an underground well supply and the transmission main capacity from the reservoir. The daily demands, however, do have a definite bearing upon the design of a filter plant, pumping equipment, distribution system and storage facilities.

Storage of Surface Supplies

The question may be asked as to when storage is needed on a river. It is a rare instance when storage is *not* required on an inland stream. Generally speaking, storage is required when the natural flow in a stream is less than that required for water supply purposes plus the water requirements of the downstream riparian owners.

The 1930-33 drought period should be used as the criteria. A typical example applicable to this question is the situation which occurred in Hanover, Pennsylvania, during the 1930 drought period. The daily demand upon the water works was 1.5 million gallons daily, and during the periods of maximum dryness the flow in the Creek was less than 200,000 gallons daily. This water supply agency was in serious trouble. The situation was corrected by the construction of impounding reservoir facilities.

Reservoir Depletion Curve Diagram

The so-called mass diagram or reservoir depletion curve diagram is a most useful tool for the engineer to use in determining the quantity of storage necessary to carry a water supply through an extended dry weather period. Its accuracy, of course, depends upon the accuracy of the data used in developing the mass diagram. Where actual stream flow gagings are not available, a synthetic curve can be produced from data obtainable from stream gagings on adjacent streams.

It is first necessary to determine the quantity of storage to be provided in a reservoir, and this is established from the mass diagram; and then it is necessary to prepare an area-capacity curve of the reservoir. This establishes the elevation of the water in the reservoir to provide for the storage required. The discussion of this phase of water supply problem may appear to be irrelevant to the subject at hand, but it is background material necessary to establish the basis upon which the cost estimates presented herein have been developed.

It is common knowledge that, in the period between May 1930 and July 1933, the lowest flow on record occurred. It is good practice to design a storage reservoir based on the assumption that the 1930-1933 drought will reoccur in the future. The safe yield from a reservoir to provide a fully adequate and satisfactory source of supply should, therefore, be based upon the minimum stream flows as they have occurred in the past. It is good judgment to think that the worst conditions have not as yet happened.

Design Criteria and Cost Data

Certain approximate design criteria are presented in this discussion because they have a bearing on the determination of the storage capacity which might be developed in a reservoir to produce various yields of water each day from a drainage area containing one square mile. This information is presented to assist the reader in evaluating this cost data, because, the cost of providing surface storage varies materially depending upon local physical conditions.[7] The values presented in Table 2 are approximate in nature and should be used with caution. The data will vary depending upon the size of the watershed, the stream runoff and other local factors.

Surface Water Supply Cost

A unit which might be established as a basis of presenting the cost of a surface water supply is the "cost per million gallons daily of safe yield of water." Naturally, the cost per million gallons daily varies greatly depending upon local conditions; and in order to present worthwhile data, eight actual cases will be cited, all based on the actual experience of the author.

1. Case of Chester, Pa.

As far back as 1870, the City of Chester, Pennsylvania, located along the Delaware below Philadelphia, obtained its water supply from that river. Because of the high pollution load at the water works intake, it was necessary for Chester to construct a new inland source of supply. In addition, Chester was faced with a periodic problem of combating the intrusion of salinity from the lower bay. There was sufficient volume of water in the Delaware River for Chester to obtain all of the water it needed at a low development cost, but the quality of the water was not satisfactory.

Chester moved from the Delaware River to an inland source of supply on the Octoraro Creek, 40-miles from the City. A 2.5-billion gallon capacity impounding reservoir; a filter plant and pumping station; 45 million gallons of water storage on the distribution system and 40-miles of transmission main were constructed at a cost of over $14,000,000. The population served is somewhat over 100,000 persons. The cost of purchasing the land for the impounding reservoir, road relocations, the construction of highway bridges, the clearing, grubbing and demolition, and the construction of the dam itself, including all appurtenances, was $2,900,000, excluding overhead.

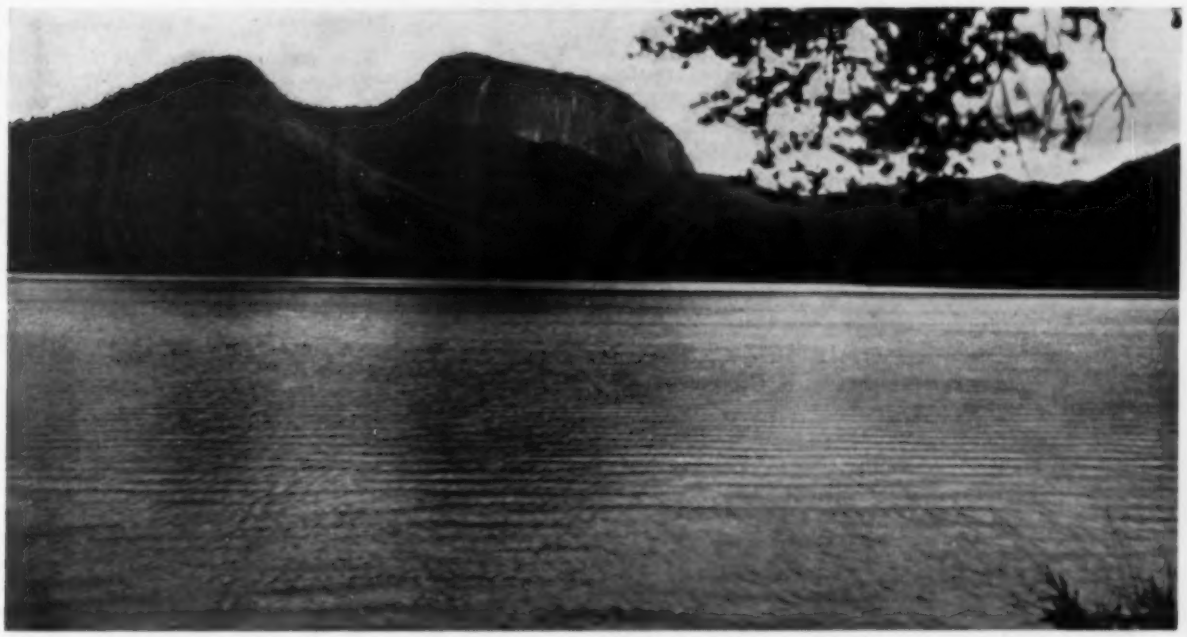
The yield from this reservoir, under the drought conditions of 1930-33 is 30 million gallons per day for water supply purposes, not including the releases required by the Pennsylvania Water and Power Resources Board (amounting to 0.25 cubic feet per second per square miles of watershed area.) The drainage area is 139.6 square miles. The dam is an earth embankment dam with a combination side hill spillway and Tainter gates. The cost per million gallons daily yield from this reservoir is $96,700.00 based on 1948 construction costs. ($136,000 based on 1954 costs).

The yield from the Octoraro Creek has not been fully developed. When necessary, additional storage can be installed to increase the yield to at least 75 million gallons daily. The Chester reservoir is a fully adequate and satisfactory source of water supply, with the design taking into consideration the future growth of the area served and the additional demands of industry. When the new supply was constructed, the water demand averaged 12 million gallons daily. In 1954, the daily demands increased to almost 18 million gallons daily. At times the peak demand exceeded 20 million gallons daily.

In the case of Chester, the cost of the 40-mile pipeline and the pumping station should be considered in evaluating the total cost picture. It is pertinent to state that the cost per foot of the 48-in. pipe complete in place was $29.00; the cost of the 42-in. pipe was $26.00 and the cost of the 36-in. pipe was $21.00. The period required for the development of the Chester supply, including preliminary investigations and construction was about 5 years. Previously it had been talked about for a period of 5 years.

2. Case of Altoona, Pa.

For many years, the City of Altoona has been faced with a water shortage, and it is believed that industry has not been attracted to that



WATER STORAGE—Table Rock Reservoir, Greenville, S. C., created by an earth dam on South Saluda River

City because of this shortage. The population of Altoona has recently decreased.

A program is now under way to increase the water supply facilities. The additional supply will include an impounding reservoir with 900 million gallons total capacity, located on the 4.4-square mile Mill Run Watershed area. The estimated cost of this reservoir is $1,780,000; and the yield will be 3.5 million gallons per day based on 1930-33 drought conditions. This construction cost is $510,000 per million gallons daily of safe yield. The dam will be constructed as an earth embankment dam with a side hill spillway.

A yield of 3.5 million gallons daily from a 4.4 square mile watershed results in a yield per square mile of almost 800 thousand gallons per day. This watershed will be fully developed for water supply purposes. The high cost per million gallons daily of safe yield results from the small area of the watershed.

The unit cost at Chester of $136,000 might be compared to $510,000 per million gallons daily yield at Altoona. Attention is called to the fact that the larger watershed area and the smaller impounding reservoir result in a lower cost per million gallons per day of yield.

3. Case of Partial Yield Development

Case No. 3 involves the construction of a dam on a stream with a storage capacity of 4.4 billion gallons, and having a watershed area of 71 square miles. This dam will be a concrete structure with an overflow spillway.

The estimated cost of the dam and impounding reservoir, including road relocations, bridges, clearing, demolition, grubbing, etc., but excluding land acquisition, engineering and other overhead, is $4,140,000. The yield from the project is 16.5-million gallons per day.

The cost per million gallons daily yield is $250,000 based on present day prices. In this instance, the yield of the stream will not be fully developed. Additional storage reservoirs will increase the 71 square mile watershed yield.

4. Case of Overflow Dam

Case No. 4 involves a concrete dam with an overflow spillway. It has a capacity of 1.95 billion gallons; a surface area of 78 acres; and a drainage area of 21.4 square miles.

The estimated yield from this development is approximately 7.5-million gallons daily and the construction cost is estimated at $1,300,000. This results in a cost per million gallons daily yield of $175,000.

5. Case of Costly Road Relocations

Case No. 5 involves a water supply reservoir with a concrete dam storing approximately 2.0 billion gallons. The drainage area in this case is 21.6 square miles, and the estimated cost is $950,000. The yield is approximately 7.5 million gallons daily and the approximate cost of the development is $127,000 per million gallons daily.

This case differs from Case 4 in that expensive road relocations are required in Case 4 which are not required in Case 5. Both of these examples include land acquisition but do not include overhead. Neither of these watershed areas will be fully developed for water supply purposes.

6, 7 and 8. Cases of Large Dams

These cases involve the estimated cost of constructing three large dams on the Delaware River and its tributaries as proposed by the Incodel project. They compromise the Wallpack Bend Dam, the Cannonsville Dam, and the Fish's Eddy Dam. These cost data trended to 1954 construction costs are summarized in Table 3.

Underground Water Supply Sources

In developing completely adequate and satisfactory source of underground water supply, the criteria differ from those which are used in developing a surface supply. If water storage facilities equivalent to between 18 and 24 hours usage, under the maximum demand day conditions, are provided on the distribution sys-

TABLE 3

Summary of Cost Data for Three Large Dams

Reservoir	Est. Cost Trended to 1954	Storage Billion Gallons	Yield M.G.D.	Cost per Mil. Gals. Storage	Cost Per M.G.D.
Wallpack Bend	$ 59,028,420	91	500	$941.00	$118,000
Cannonsville	48,162,500	88.1	371	547.00	130,000
Fish's Eddy	114,712,647	117.8	479	973.00	240,000

TABLE 4

Cost and Related Data on Gravel Packed Wells

	Case 9 Morrisville, Pa.	Case 10 Rehoboth Beach, Del.	Case 11 Navy Yard, Phila.	Case 12 New Castle, Del.	Case 13 Millville, N. J.
(1) Year Drilled	1951	1951	1945	1951	1954
(2) Size of Outer Casing	24"	20"	24"	16"	18"
(3) Size of Inner Casing	10"	12"	18"	10"	12"
(4) Depth of Well	170'	125'	80'	140'	145'
(5) Yield—GPM	700	750	500	500	700
(6) Head of Pump	350'	150'	180'	140'	210'
(7) Cap. of Pump—G.P.M.	700	750	500	500	700
(8) Cost of Well	$16,000		$ 8,230	$ 5,960	$ 9,428
(9) Cost of Pump	$ 3,500		$ 2,875	$ 3,354	$ 5,741
(10) Total Cost	$19,500	$11,050	$11,105	$ 9,314	$15,169
Total Cost Price Trended to Oct., 1954	$23,600	$13,000	$23,100	$11,300	$15,200
Cost per 100 G.P.M. Yield as of Oct., 1954	$ 3,370	$ 1,740	$ 4,620	$ 2,260	$ 2,160
Cost per million gals. daily as of Oct., 1954	$23,600	$12,200	$35,300	$15,800	$15,200

tem, then a deep well supply should be capable of supplying the maximum daily demand with at least one standby well. On the other hand, if the capacity of the storage facilities on the distribution system is, for example, only 5 hours of water usage, then the deep well supply should be developed for the maximum rate of consumption for a 3 hour period, or approximately 3.5 times the average daily rate with at least one standby well.

Underground Water Supply Costs

An analysis has been made of five different well supplies, which are designated as Cases 9 to 13 inclusive. All these supplies are gravel packed type wells and are equipped with deep well turbine pumps. The cost and other data regarding these deep wells are given in Table 4.

The cost per 100 gallons per minute yield from a deep well supply, involving gravel packed wells, will vary from a minimum of $1,740.00 to a maximum of $4,620.00. This is a "bare bones" cost and does not include connecting piping, electric lines, etc.

If, however, a rock well is drilled with a probable yield of considerably less than a gravel packed well, then the cost per 100 gallons per minute yield usually will be greater than that of a gravel packed well. In certain instances, large volumes of water have been obtained from rock wells, thus resulting in low cost water.

Summary of Cost Data

The tabulation in Table 5 summarizes costs on the thirteen different water supply projects which have been discussed.

Conclusions

A completely adequate and satisfactory source of water supply should consider the future growth of a community, and water agencies will be prudent to anticipate an increased demand in the design of supply facilities. A water supply project should look forward to a growth at least 25 years in the future; where a supply can be conveniently extended, such as in the case of a deep well source, or where new surface supplies can be made available, then it is unnecessary to construct facilities for the too distant future.

It is difficult and expensive to enlarge dams and tunnels. Dams should be constructed to develop the full reservoir site capacity. when economically feasible, even though the design at the present does not require it. This does not necessarily mean that the stream or watershed area should be fully developed. This development can be done progressively in step fashion. Tunnels and long pipelines which cannot be enlarged while still being kept in service should be built to anticipate a more distant future demand than the 25-year period.

A good example of step construction on a long pipe line is that which was utilized at Chester. This 40-mile transmission main was designed for a capacity of 30 million gallons daily. The pipe was designed structurally for a pressure in excess of the pressures created when the water was flowing at the rate of 30 million gallons daily. Provision was made in the line to install, when necessary, a booster pump which would make possible an increase in the capacity of the pipe line from 30 million gallons daily to 40 million gallons daily. This same

TABLE 5

Cost Data Summary

Case No.	Type of Supply	Cost per M.G.D.
1	Surface	$136,000.00
2	Surface	$510,000.00
3	Surface	$250,000.00*
4	Surface	$175,000.00
5	Surface	$127,000.00
6	Surface	$118,000.00
7	Surface	$130,000.00
8	Surface	$240,000.00
9	Well	$ 23,600.00
10	Well	$ 12,200.00
11	Well	$ 35,300.00
12	Well	$ 15,800.00
13	Well	$ 15,200.00

* Exclusive of land acquisition.

provision was made in the pipe which conveys the water from the impounding reservoir to the filter plant. The Chester pipe line as presently constructed should be capable of serving the municipality for more than the next 25 years; and, when the booster pumps are installed, the line will then be capable of serving Chester for possibly 50 years in the future.

Since cost is a controlling element in reaching a decision in planning for the future, step construction is good practice when it is carried out in accordance with a predeveloped plan.

Finally, a good example of completely adequate and satisfactory source of water supply, constructed at a cost which the traffic will bear, is also provided by the City of Chester. The supply facilities were constructed at a cost of $136,000.00 per million gallons daily safe yield based on present day construction costs. The stream with its impounding reservoir will yield 30 million gallons daily. A reasonable future growth has been anticipated. The 1954 Summer peak demand was 20 million gallons daily. For the past 3 years, this municipality has enjoyed the benefits of a satisfactory and adequate source of water supply at a reasonable cost. The supply has successfully handled the population increase and the added industrial load.

References

1. Paper presented at 1954 meeting of the Penna. Section, A.W.W.A. by L. D. Matter, Assistant Chief Engineering, Penna. Dept. of Health.

2. Paper delivered by C. G. Paulsen, Chief Engineer, Water Resources Division, U. S. Geological Survey, at Industrial Conf. on Water and Sewerage, June 29, 1954, on "Water Shortages of 1953."

3. "Public Water Supply Shortages—1953" by K. A. MacKichon and J. B. Graham, U. S. Geological Survey, Water Resources Division.

4. Public Works Magazine, May 1953, "What About Increased Water Use and Water Shortages?"

5. Geological Survey Circular 257—"The Use of Water in Pennsylvania—1951."

6. "The Problems Arising From Increase in Water Demands" by Gail A. Hathaway, Special Assistant to the Chief of Engineers, Department of the Army.

7. "Report of Committee on Yield of Drainage Areas," Volume XXVIII, New England Water Works Association.

Water Supply Teaching Aids Available from AWWA

A manual of "Teaching Aids" has just been published by the American Water Works Association to supplement its popular, 16-page, full-color booklet, "The Story of Water Supply." Designed for sixth to ninth graders, this booklet recounts some highlights in the history of water supply and, in simple yet technically accurate terms, tells how today's water systems collect, purify, and distribute their supplies.

Since its publication early in 1954, nearly 400,000 copies of "The Story of Water Supply" have been distributed by water utilities to their local customers and to schools as a public relations measure. The booklet has aroused such interest that the Association commissioned educational consultant Burnett Cross to develop the companion folder, "Teaching Aids," to help science and civics instructors to use the presentation to best advantage. The 4-page manual gives stimulating suggestions for classroom demonstrations, field inspection trips, creative projects, and individual and group research. A glossary of technical terms used in "The Story of Water Supply," and a list of recommended supplementary reading, are included.

"Teaching Aids" will normally be distributed to purchasers of "The Story of Water Supply" without extra charge, in a ratio of one free copy to each 50 picture booklets. Separate copies of "Teaching Aids" may be obtained from the American Water Works Association at a cost of 5¢ per copy, payable in advance. The single copy price of "The Story of Water Supply" is 15¢, with quantity prices dropping to as low as 2¢.

"Miss Ryan" Dies Suddenly —Long W&SW Secretary

Mrs. Sally Ryan Lamb, Secretary to the Editor of Water and Sewage Works, died suddenly on March 12, 1955. She was familiary known as "Miss Ryan" to many of our readers and advertisers.

"Miss Ryan" came to the magazine in April 1930, and had nearly completed twenty-five years of service as a loyal and capable member of the staff. "Miss Ryan" was a friendly name and personality known to almost everyone who called at or telephoned to the New York office. It is with deep regret that "Miss Ryan's" family, friends, and co-workers note her untimely death.

FSIWA Moves Headquarters Office from Champaign To Washington

Announcement has been made by Ralph E. Fuhrman, Executive Secretary-Editor, that the Federation of Sewage and Industrial Wastes Assns. has moved its headquarters office from Champaign, Ill., to 4435 Wisconsin Avenue, N.W., Washington 16, D. C. The telephone number of the Washington office is EMerson 2-4100.

Nine-Year Fluoridation Report Issued by Sheboygan, Wis.

Fluoridation of the Sheboygan, Wis., public water supply was started on February 25, 1946, with the maintenance of a 1.0 ppm concentration of fluoride ion. Dental surveys are made in October each year. The survey data reported by the Wisconsin State Board of Health, up to and including the 1954 data, are summarized herewith. Improvement, as measured by the DMF rate, appears to consistently follow predictions.

Sheboygan, Wis. Schools Dental Survey Data

Year	No. Children Examined	DMF Improvement Since 1945
	KINDERGARTEN CHILDREN—DECIDUOUS TEETH	
1945	416	(pre-fluoride)
1946	520	10.0%
1947	521	14.8%
1948	525	27.9%
1949	386	39.6%
1950	404	46.2%
1951	456	53.7%
1952	668	58.5%
1953	524	62.9%
1954	549	65.0%
	7TH, 8TH, 9TH GRADES—PERMANENT TEETH	
1945	1877	(pre-fluoride)
1946	1590	5.28%
1947	1642	14.8%
1948	1442	19.0%
1949	1566	18.0%
1950	1522	21.9%
1951	1519	23.4%
1952	1497	29.7%
1953	1494	37.1%
1954	1486	40.7%

DMF is average number of Decayed, Missing due to decay, and Filled teeth per child.

Maintenance of Filter Instruments

Routine maintenance, part replacement and new equipment are required to operate 80 filters in Chicago's South District Water Filtration Plant

by TIMOTHY D. NULTY

Mr. Nulty is Water Chemical Engineer, Bureau of Water, Dept. of Water and Sewers, Chicago, Ill. His paper summarizes maintenance experience over a seven-year period. It first appeared in "Pure Water", the Department's publication for promoting in-service training, and is here published with permission.

THE first of the 80 filters of Chicago's South District Filtration Plant were placed in service February 22, 1947. By May of 1947 all water leaving the plant was filtered. The last filter was placed in operation November 13, 1947. These filters have operated continuously since that time except for the period from January 18, 1952 through January 31, 1953 when, for the purpose of obtaining data pertaining to high rate filtration, only 50 filters were used. During this particular period, 12 fixed rate filters were kept in continuous operation and the remaining 68 filters were rotated in and out of service to divide the time in service equally.

Over this 7-year period a certain amount of maintenance work has been necessary to keep the instruments and appurtenances connected to the filters in operation. The largest number of manhours of work has been expended on routine maintenance, such as packing and adjusting sealing glands, cleaning screens and filters, and lubrication. The next largest expenditure of manhours has been in replacing worn or defective units or parts of units. In addition, several pieces of equipment have been installed to minimize the amount of maintenance work.

Soft Water Not Needed

Some equipment of this type was installed with the original equipment in the plant. Water softeners were installed on the low pressure hydraulic lines which operate the filter rate controllers. The first softeners were of insufficient capacity and were replaced by larger softeners. The latter gave trouble by passing salt into the discharge, causing the pilot valves on the rate controllers to clog. Use of the softeners was discontinued in 1950, and ordinary process water has been used up to the present time without difficulty.

Removing Air from Oil

Another piece of equipment that has given trouble is the electrodryers located on the +6 floor on the west side of the filter building. The purpose of these electrodryers is to remove oil and moisture from the compressed air used for the operation of the instruments connected to the filters. It is necessary to remove the oil from the air for it tends to collect at the various tiny needle and ball check valves located at several points in the system and render them inoperative.

At the east end of each filter gallery a cellulose filter was added to the air supply line to aid the electrodryers. Even after this addition was made, some oil and moisture managed to pass, requiring still another electrodryer unit (an Electro-Filter), which was installed recently. (See Fig. 1) The air supply to the instruments now seems to be reasonably free of oil and moisture.

An Emergency Air Supply

In the early days of operation there were occasional failures in the air supply to the filter controls. (The air is drawn from the plant air-system, supplied from compressors in the boiler room.) The automatic filter rate controllers depend on the back-pressure in the air system to maintain the required filter rate. When this back-pressure drops to zero, these rate controllers operate to their maximum capacity and cause danger of overflowing the filtered water reservoirs.

In the first effort to overcome this hazard, air-storage tanks capable of supplying the needed pressure for three hours were installed in each filter gallery. Between each tank and the air supply system, check valves were installed. Should the air pressure fail, the tank supplies air until the system is again placed in normal service. The tank air pressure is at 100 lb. per sq. in. This is first reduced to 18 lbs., and then to 3 lbs. for application to the filter controls.

As a secondary safeguard, diaphragm valves, counter-weighted and

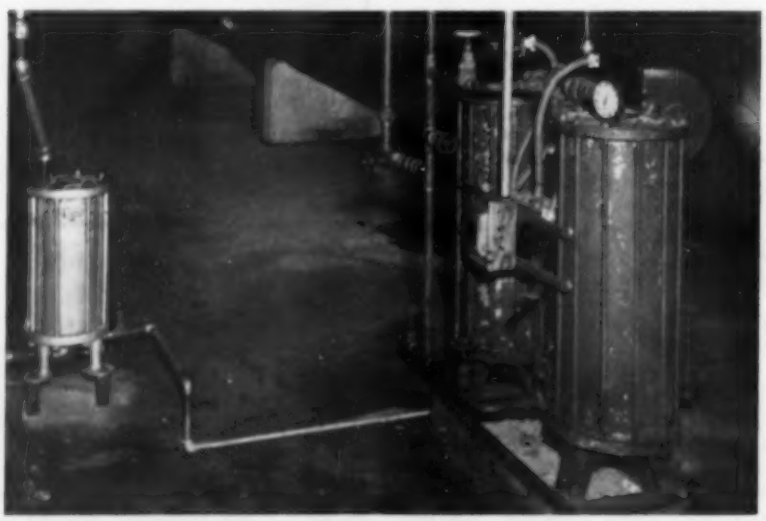
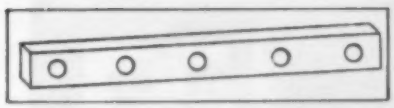


Fig. 1—OIL-FREE-AIR to operate instruments is provided by combination of additional Electro-Filter and Electro-Dryer units



SKETCH illustrating original construction of copper high pressure water manifold

with the spring tension set to close at 10-12 lbs., were installed between the 18 lbs. and 3 lb. pressure reducing valves in each gallery. Should the air pressure drop below the set point, the diaphragm valves close, locking the automatic rate controllers at the rate then prevailing. These diaphragm valves are carefully checked once each shift so as to be sure they are in an operable condition.

Filter Gallery Dehumidification

In addition to the original equipment, whose prime purpose was to minimize maintenance, more equipment has been added over the period of 7 years for the same purpose. The most extensive of these additions are the 3 Kathabar units used for the dehumidification of the filter galleries and the west pump room. Two previous articles in the Bureau's monthly "Pure Water" publication, "Dehumidification of Pipe Galleries at the South District Filtration Plant" by Mr. F. G. Gordon (July, 1951), and "Dehumidification at the South District Filtration Plant" by Mr. Arthur Horwitz (October, 1951), cover this subject very thoroughly.

Leaks in High Pressure Lines

The large filter valves are operated by high pressure hydraulic water which is controlled by means of 4-way valves in the filter operating table located on the gallery side of the filter on the operating floor. Each filter table contains five 4-way valves which are connected to a supply and a discharge manifold. Some troubles have been encountered with the 4-way valves leaking and sticking, but most of the time the trouble has been remedied by cleaning the old lubricant from the valve and relubricating.

The most serious trouble in this particular part of the filter appurtenances has been with the hydraulic water manifolds developing leaks. The original copper manifolds were made as shown in sketch "A." Due to the fact that these manifolds were made in one piece, when a leak occurs, it is necessary to remove the entire manifold to repair it. This old type manifold is now being replaced by one made up of several small pieces of round copper tubing with soldered fittings.

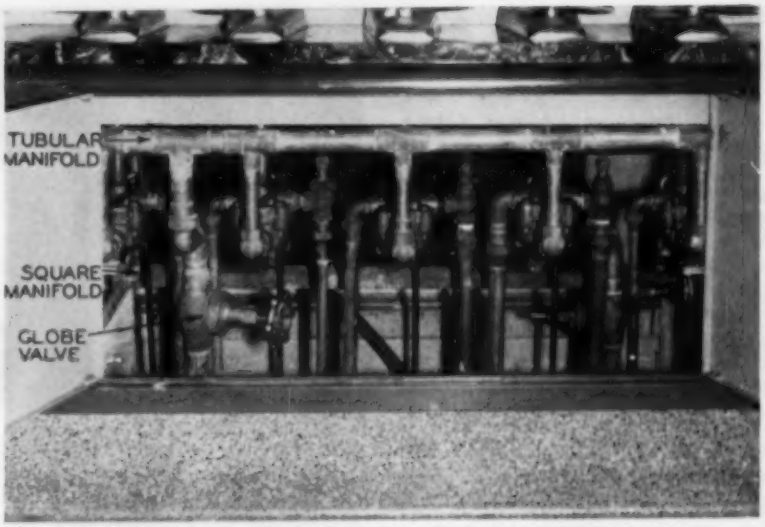


Fig. 2—NEW TYPE MANIFOLD made of copper tubing with soldered fittings—easier to repair—replacing original single-piece units

Fig. 3—PENDULUM UNIT which poistions rate controller valve, and manometer cart which provides series of calibration test instruments

The new type manifold has 2 advantages over the older type: (1) when a leak develops only that portion of the manifold having the defect must be removed and replaced. (2) the location of the new manifold in the filter table permits work to be done on the 4-way valves more easily. As of the writing of this report, 31 new type manifolds (See Fig. 2) have been installed. As more old manifolds develop leaks they will be replaced.

Globe Valves Replace Gates

On the original installation, the hydraulic water supply lines had a 1½-in. shutoff valve, located under the filter tables, which was a gate valve with a small hand wheel. This valve was found to be very unsatisfactory in that the 135 lb. pressure (maximum) on this line was causing severe wire drawing on the valve seats and discs and in addition the operators were having trouble opening and closing the valves due to the size of the handwheel. All 80 of these valves have been replaced by globe valves with large handwheels which seem to be functioning properly. (See left side of Cabinet in Fig. 2)

Filter Control Diaphragm Corrosion

Each filter is equipped with a diaphragm operated pendulum unit which governs the position of the butterfly valve in the rate controller. The most prevalent source of trouble in the unit is with the diaphragm rupturing. To date, 33 diaphragms have been replaced in the pendulum units. One other trouble encountered in these units is with the small pilot valve sticking. However, this trouble is very easily remedied by cleaning the plunger rod.

The water supply to this unit and the discharge to the rate controller must pass through strainers. These strainers must be cleaned periodically to maintain proper operation of the unit. To prevent excessive corrosion of the bottom side of the diaphragm chamber, these units are being raised approximately 2-in. off the floor by extending the legs. This work is being done when a diaphragm is replaced, and to date 33 of the units have been raised. (See Fig. 3)

Low Rate Filter Operation

Two adjustments on these pendulum units have been found to give better operation. As first installed, there was a tendency for the automatic filters to shut off entirely when the demand rate dropped below 2.5 mgd per filter. By adjusting the long connecting rod between the diaphragm and the bellows to its full effective length, these filters now continue to operate at rates as low as 1.3 mgd. The second adjustment was on the tension applied to the diaphragm. This was formerly set with the rate controller manually fixed at zero. This gave what is called locally a "Dead Zero." This means the rate controller when showing "zero" could just be locked against the zero pin with some flow still occurring. By adjusting the tension with the rate controller set manually at 3 mgd a "Floating Zero" is obtained. With this adjustment when the rate controller indicated zero there is no flow.

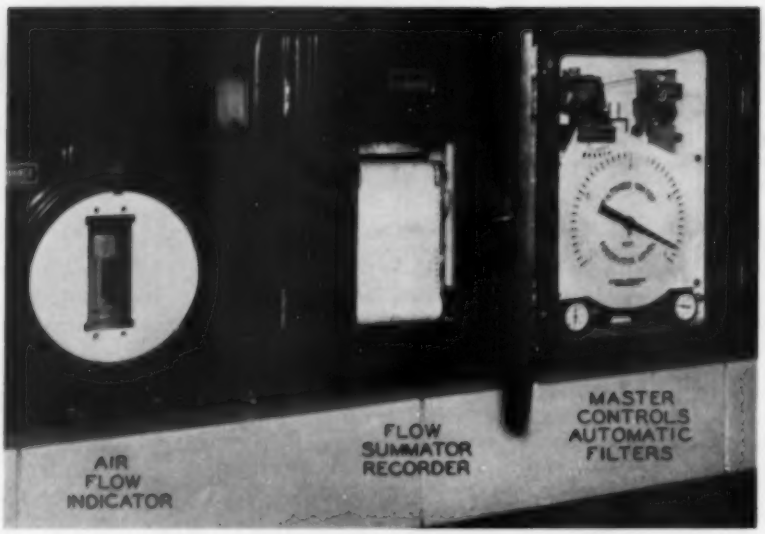


Fig. 4—AIR FLOW INDICATOR panel recording flow summator and master controls for automatic filters

Maintenance of Instruments

The last equipment to be dealt with in this report are the filter instruments. Each of the 80 filters is equipped with a transmitter and a receiver for the loss of head, the rate of flow and the sand expansion gauges. The rate of flow and loss of head transmitters receive two different water pressures and transforms the difference in these two pressures to air pressure which in turn is transmitted to the receivers. The sand expansion transmitter receives a differential air pressure which is transmitted to the receiver. One can readily understand the necessity of a continuous supply of clean, dry air which was mentioned previously.

The rate of flow and loss of head transmitters (See Fig. 3) have required more maintenance, other than routine maintenance, in that some of the Lucite mercury wells have developed cracks due to thermal expansion and contraction, causing loss of mercury, thereby delivering incorrect results to the receiver charts. As these wells develop cracks, they are replaced by wells of a new design which so far have not shown any evidence of cracking. To date, 18 of these wells have been replaced and it is expected that all 160 will have to be replaced within the next few years.

Another part that is beginning to require replacement is the small diaphragm which operates the transmitter. After 7 years of operation they are beginning to rupture. Approximately 10 diaphragms have been replaced thus far.

Calibration Manometers Are Portable

For routine calibration of the rate of flow and loss of head instruments a series of manometers have been installed on a cart for mobility. (See Fig. 3) The manometers are valuable in checking the rate of flow and loss of head recorders.

In addition to the individual filter instruments, there are flow summators which indicate and record the flow through 40 filters. Each gallery also has its own backwash water rate of flow indicator and recorders as well as a rate of flow indicator and recorder for the surface wash water. These last mentioned instruments require very little maintenance, but occasionally a diaphragm or a cracked mercury well must be replaced. Figure 4 shows air flow indicator, recording flow summator (for 2 galleries) and master controls for automatic filters.

Multiply Replacements by Eighty!

This report does not mention parts of the filter such as the sand and gravel bed, the under drainage system, the surface wash system, the wash water troughs or the five large gate valves. It has been the aim of the writer to point out the exceptional problem of maintenance work over and above normal maintenance which has been, and still is necessary where such a large number of filters are being operated. No matter what part is found defective, one can multiply the number of manhours necessary for one such replacement by 80.

The writer wishes to extend a note of thanks to Filtration Engineer, Mr. Carl Chevedden, who was of great help in the preparation of this report.

WATER WORKS PRACTICES

Instrumentation and Control

The Twenty-first of a Series

by GEORGE E. SYMONS, Ph.D.

Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

IN AN EARLIER lecture, the subject of Flow Measurement was presented. Included in that lecture was a discussion of the reasons for flow measurement, location of metering points, metering devices and secondary instruments.

The subject of instrumentation and control is broader than flow measurement, but naturally includes it. Therefore, some of the material presented in this lecture will sound familiar since it will refer to material previously discussed.

A . . . Basic Considerations

1. DEFINITIONS

a. *Instrumentation* is the term applied to that subject which deals with the selection, installation, application and use of instruments.

b. *Instruments* are devices used to convert measurements of physical or chemical conditions, as determined by a sensing unit, into observable information on the condition, operation, or result of some situation or action. These devices are usually termed secondary instruments or receivers or gages while the sensing device is termed a primary measuring device, primary unit or sometimes simply a meter.

c. *Control* is the term applied to the selection, installation, application and use or operation of controller devices which regulate the functioning of other devices or regulate physical actions or conditions or chemical reactions.

2. REASONS FOR INSTRUMENTATION

a. To provide data and information on plant production.

(1) Rate of plant output.

(2) Total plant output in unit period.

(3) Individual unit output (wells, filters, pumps).

(4) Pressure in lines.

(5) Power consumption.

b. To provide information on operating efficiency.

(1) Total plant.

(2) Unit operations (coagulation, sedimentation, filtration, disinfection, pumping).

(3) Well operations; individual and total.

c. To determine quantity of water sold.

(1) Interconnections.

(2) Wholesale.

(3) Individual consumer.

(4) Non-revenue water.

d. To ascertain costs of operation.

(1) Per million gallons.

(2) Per unit operation.

(3) For management, taxpayer or stockholder.

e. To establish records of permanence.

(1) For management and supervision.

(2) For future planning.

(3) For health departments.

(4) For owners (stockholders or taxpayers).

(5) For litigation purposes, if needed.

3. REASONS FOR CONTROL

a. To maintain desired operating conditions.

(1) Levels in reservoirs, wells, sedimentation basins.

(2) Pressure in lines.

b. To maintain desired production.

(1) Rate of flow in main lines.

(2) Unit operations—filtration, pumping.

(3) Plant output.

c. To establish and maintain proper treatment.

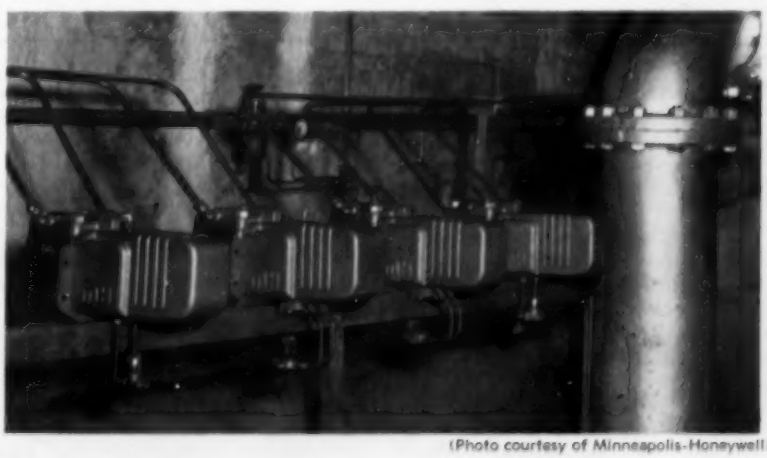
(1) Coagulation chemical feed.

(2) Disinfection.

(3) Filter washing.

(4) Softening.

(5) Taste and odor control.



(Photo courtesy of Minneapolis-Honeywell)

Fig. 1—PNEUMATIC transmitter units

TABLE 1

Water Works Operations Utilizing Instrumentation and Control*

PROCESS	INSTRUMENTATION							CONTROLS						
	Flow	Level	Loss of Head	Potentiometer	Pressure	Auto-control	Chem. Feed	Filter Rate	Flow	Level	Pressure	Pressurestat	Pump	Butterfly Valve
SOURCE OF SUPPLY:														
Reservoirs		√								√				
Raw Water Intake		√												√
Low Service Pumps	√												√	√
Wells:														
Pumps	√								√		√		√	√
Discharge Lines	√				√				√		√			√
Level		√								√				
COAGULATION		√					√							
SEDIMENTATION		√								√				√
Sludge Removal		√											√	√
FILTRATION:														
Filter Effluent	√		√					√						√
Filter Influent		√												√
Filter Wash	√					√							√	√
Surface Wash	√													√
Sand Expansion		√												
DISINFECTION							√							
TASTE AND ODOR CONTROL							√							
FLUORIDATION							√							
SOFTENING:														
Chemical Feed							√							
Sludge Removal	√												√	√
Recarbonation	√							√						
Ion Exchange	√								√					√
LABORATORY CONTROL:														
Chlorine Residual				√			√							
pH				√			√							
Turbidity				√			√							
DISTRIBUTION SYSTEM:														
Clear Well		√								√				
Transmission Mains	√				√				√		√			√
Arterial Mains	√				√				√		√			√
Booster Pumps	√				√				√		√	√	√	√
Elevated Storage		√			√				√		√	√		√

* Adapted from Keep Sheet No. 28 of B-I-F Industries, Inc., by permission.

4. MEASURED VARIABLES

a. Instrumentation is used for measurement of:

Flow, level, loss of head, physical characteristics (pressure and temperature), and chemical characteristics, i.e., pH, chlorine residual, oxidation-reduction potential (ORP), etc.

b. Control is applied to flow, level, pressure, chemical dosage, filter operation, temperature, humidity, chemical characteristics of water, etc.

5. POINTS OF USE

a. Primary measuring devices and their accompanying secondary instruments or receivers are chosen for the particular process operation and the particular variable to be measured.

b. Control mechanisms, likewise, are chosen according to the process operation and measured variable to be controlled.

c. Table 1 shows the various processes or operations in a water works to which instrumentation and control are applied, and the variable measured or controlled for each unit process.

d. Table 2 shows the measured variable sought and the location, process or item for which these variables are determined; also shown are the type of primary and secondary instrument or control used for each application.

e. A careful study of these tables will reveal the locations within water works system where instrumentation and control are important factors in good design, management, and operation.

B . . . Instrumentation

1. PRIMARY DEVICES

a. Flow may be measured by:

(1) Head-area meters: Weirs, open-end nozzles and measuring flumes (Parshall flume).

(2) Functional meters or mechanical devices which measure some function of volume in motion.

. . . Differential head devices: Venturi tube, Dall Flow tube, Gentile flow tube, insert nozzle, flow nozzle and orifice.

TABLE 2

Measured Variables Subject to Instrumentation and Control*

MEASURED VARIABLE	PRIMARY MEASURING DEVICE									SECONDARY INSTRUMENT					CONTROL			
	Bubble Pipe	Differential Producer	Displacement Meter	Float	Head-Area Meter	Potentiometer	Pressure Sensor	Propeller	Rotameter	Totalizer	Indicator	Recorder	Summator	Ratio	Flow Rate	Chem. Feed	Level	Pump
FLOW:																		
Raw Water Intake		√			√			√		√	√	√	√	√	√	√		
Raw Water Pumpage		√			√			√		√	√	√	√		√	√		√
Filter Effluent		√								√	√	√	√		√			
Finished Water		√						√		√	√	√	√		√	√		√
High Service Pumpage		√						√		√	√	√	√	√				√
Distribution System		√						√							√			√
Booster Pumpage		√						√		√	√	√	√	√	√			√
Wash Water to Filter		√						√		√	√	√			√			
Wash Water to Storage		√						√		√	√	√				√		
Plant Water Supply			√					√		√		√						
Chlorine Solution									√							√		
Cl_2, NH_3, SO_2		√							√	√	√	√				√		
CO_2		√	√						√	√	√	√			√			
Chemical Feed										√	√	√				√		
LOSS OF HEAD:																		
Filters							√				√	√						
LIQUID LEVEL:																		
Reservoir or River	√			√							√	√					√	
Settling Basin	√			√													√	
Clear Well	√			√							√	√					√	
Distribution Reservoir	√			√							√	√			√		√	
Wash Water Tank	√			√			√				√	√					√	
PRESSURE:																		
Wash Water							√				√	√						
High Service Suction	√			√			√				√	√						
High Service Discharge							√				√	√			√			√
Distribution							√				√	√			√			√
MISCELLANEOUS:																		
Chlorine Residual						√					√	√				√		
Fuel Oil Tank				√							√							
pH						√					√	√				√		
Sand Expansion				√							√							
Temperature											√	√						
Turbidity											√	√						
Water Hammer							√				√	√						

* Adapted from Keep Sheet No. 28 of B-I-F Industries, Inc., by permission.

. . . Velocity meters—propeller type.

. . . Pitot tubes.

(3) Displacement meters.

(4) Constant differential meter—Rotameter.

(5) Inertial flow meter—Gyroflow meter, massometer.

(6) Pumps.

b. For a more complete discussion of flow measuring devices, refer to the lecture on Flow Measurement.

c. Other primary measuring or sensing elements include:

(1) Bubble pipe or diaphragm bulb—for level or hydrostatic pressure.

(2) Float—for level.

(3) Bourdon tube, bellows, or diaphragm—for pressure.

(4) Sand expansion level.

(5) Sensing cell for pH, residual chlorine, ORP.

(6) Photoelectric cell for turbidity, color, etc.

(7) Thermometer for temperature, barometer for atmospheric pressure, hygrometer for humidity, anæmometer for wind velocity, and rain gage for precipitation.

2. TRANSMISSION

a. Secondary instruments are classified in two ways:

(1) According to type of device used to transmit the sensed variable to the receiver.

(2) According to type of information desired.

b. There are three types of transmission:

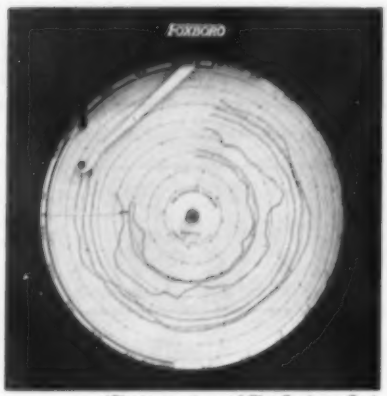
(1) Mechanical: The secondary instrument is actuated by a cable between the two devices or by pressure tubes between the two, or by two cables attached to floats in stilling wells attached to the take off points of the primary unit, or by direct mercury well float actuation for differential pressure or level. The cable may be attached to the arm of a diaphragm pendulum unit.

. . . Liquid level and loss of head units or gages use one cable; differential producers use two cables attached to floats in stilling wells connected to the pressure take off points on the primary unit.

. . . A single cable may run from the receiver to a diaphragm pendulum unit; this latter unit is an intermedi-

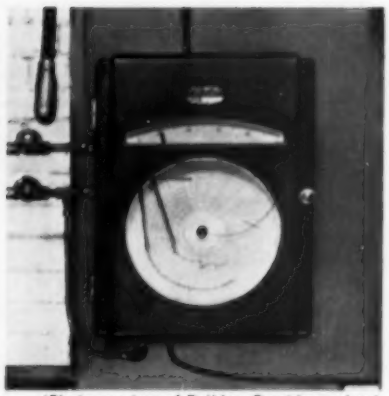
(Photo courtesy of Simplex Valve & Meter Co.)

Fig. 2—LARGE dial indicator gage



(Photo courtesy of The Foxboro Co.)

Fig. 3—RECORDER instrument



(Photo courtesy of Builders-Providence, Inc.)

Fig. 4—TOTALIZER-indicator-recorder

ate device for converting differential pressure directly into a linear function.

... Valve position may be transmitted by bead chain operating in a copper tube from valve to dial indicator.

(2) Electrical: The secondary instrument is actuated by a timed electric impulse (Chronoflo Telemeter) whereby the duration of the electrical impulse is proportional to the magnitude of the measured variable (flow, pressure, level or other characteristic).

... The electrical transmitter contains a cam, synchronous motor and magnetically operated mercury switch. The cam rotates at a constant speed, usually four revolutions per minute. A cam-shoe, riding on the rotating cam moves the magnet away from the mercury switch causing the switch to close and send a signal to the receiver. The cam-shoe is positioned by the function being measured, and the length of time the cam-shoe rides on the cam-face determines the time the switch is closed. This time interval varies directly with the magnitude of the variable being measured.

... Electrical transmission can be used over private wire circuits (A.C. or D.C.), over telephone circuits, or multi-service wires for any distance from a few feet to miles.

... Sequence-unit transmitters will transmit signals from several transmitters consecutively over the same pair of wires. Sequence-unit transmission is useful for the operation and control of well field pumps and booster stations.

(3) Pneumatic: For distances up to 1000 feet, transmission by air pressure is effective. The device makes use of varying-controlled-air pressure ranging from 3 to 15 psi. (See Fig. 1.)

... Changes in pressure output of the transmitter are proportional to changes in the measured variable.

... No wires are used; the output signal (pressure) is continuous and extremely sensitive to change in the measured variable.

3. Secondary Instruments

a. When classed according to information desired, there are six types of secondary instruments: Indicators, Totalizers, Recorders, Combinations, Summators, Flow-Ratio.

(1) Indicator—frequently called a gage—it shows conditions only at the moment of observation. (See Fig. 2.)

... Gages are used to indicate rates of flow, loss of head, pressure, level, sand expansion in filters, valve position, temperature, meteorological conditions, chemical dosage rates, pH, chlorine residual, ORP, turbidity; in short, any measured variable. (See Figs. 6 and 7.)

... Indicators are of four types: a sweep arm moving over a graduated dial face, an arm traversing a graduated arc, an arm (pointer) traversing a graduated scale or a fixed pointer and a moving graduated dial. Graduations may have linear or square root spacing, depending on the instrument characteristics and the variable being measured.

(2) Totalizer — also called a counter, integrator, or register — a counting mechanism which converts a sensed variable of quantity in motion, during a period of time, into the numerical value representing the total quantity moving during that period; that is a running total of the quantity which has moved in an elapsed time.

... Totalizers are used for flow measurement and chemical feed measurement.

(3) Recorder—sometimes called a chart recorder—it gives a permanent

(Photo courtesy of Simplex Valve & Meter Co.)

Fig. 5—GAGE and recorder for loss-of-head and filter effluent rate

record of changes in conditions throughout a period of time.

... Charts may be circular or strip type and may cover time intervals of a few hours to a week or month. (Fig. 3.)

... Scale divisions on the chart will depend on the design of receiver, or on the variable being measured or both. For example, flow charts for differential meters may be of the square root type (with divisions spaced proportional to the square root of the differential or square of the flow); chart readability is best at the high end of the scale. They may be linear with scale divisions spaced equally. In the latter, the receiver or transmitter contains a cam or shaped well and float which extracts the square root of the differential—its readability is accurate throughout the range.

... The permanent record may be a continuous inked line or a succession of tiny inked dots or bars.

... Recorders are used for rate of flow, total flow, loss of head, liquid level, pressure, temperature, barometric pressure, chemical dosage rates, loss in weight of chemical feed, pH, ORP, residual chlorine, turbidity, etc.

(4) Combinations—of these three types of instruments are available. For measurements of flow, Totalizer-Indicator-Recorders (Fig. 4) or Totalizer-Recorders are used; for measurements of level, pressure, chemical dosage, chemical characteristics, etc., Indicator-Recorders are used (see Fig. 5). Gages and recorders for several functions are frequently mounted together in a centrally located panel (Fig. 6).

(5) Summators—Two or more flow rates of pump discharges, mains, filters, etc., may be added together to give the total flow rate or total flow on a single receiver.

... The summator may be either electrical or pneumatic; it receives signals from several individual transmitters, adds them together and transmits the result to the single receiver.

(6) Ratio-Gages—Ratios of two independent flows can be continuously indicated and recorded. For this operation, pneumatic transmitters, summators, and an anti-log computer are used.

... The anti-log computer receives air pressures representing the two independent flows and mechanically subtracts the logarithms of the flows (existing as pressures). The resultant air pressure represents the ratio of the two input pressures and thus the ratio of the flows.

... The ratio of two metered flow rates is useful in water softening plants where split treatment (mixing hard and soft water) is used. Mixtures of well waters of different characteristics also can be observed with this system as can the output of two well fields or two supply sources.

(Photo courtesy of Builders-Providence, Inc.)

Fig. 6—PANEL of indicator gages

b. For the application, use, and location of instruments, see Table 1 and 2.

4. SELECTION OF INSTRUMENTS

a. In choosing a secondary instrument, there are a number of factors to be considered.

(1) Type and location of primary measuring device: This may dictate the transmission method by which the secondary unit is operated. This is particularly true in flow measurement where transmission may be by cable, differential pressure, air, or electricity. The type of transmission depends on relative locations and what accomplishment is desired.

(2) Accuracy desired: Accuracy depends on the combination of primary device and secondary instrument. The subject of accuracy is more fully discussed below.

(3) Relative location of primary device and secondary instruments: This is especially important in the selection of transmission systems.

(4) Type of information desired: Totaled, indicated, recorded or combinations.

(5) Range of variable: The ratio of maximum to minimum of the variable being measured must be known, whether 4 to 1, 10 to 1, etc. This factor is particularly important in flow measurement.

(6) Future capacity: Is the measured variable expected to increase above the current maximum?

(7) Expected life: Obsolescence or short life of an instrument can add greatly to the cost of equipment and operation. Instruments should have a life expectancy equal to or greater than the life of bonds financing the project.

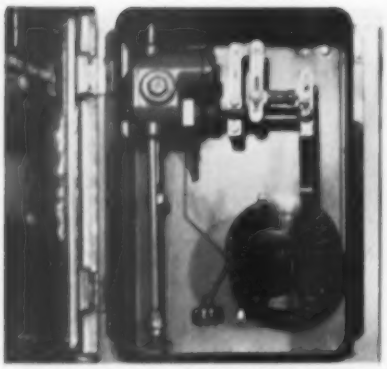
(8) Secondary functions required: Are secondary instruments to be part of a control system?

b. Accuracy is a term that has several interpretations. In instrumentation, "accuracy" usually is a measure of the limit of error from the true value.

(1) Accuracy may be expressed in three ways:

Plus or minus (±) Y per cent of actual reading.

Plus or minus (±) Y per cent of full scale.



(Photo courtesy of Builders-Providence, Inc.)

Fig. 7—PROGRAM controller

(Photo courtesy of Builders-Providence, Inc.)

Fig. 8—FILTER effluent rate controller

Plus or minus (±) Y per cent as average error.

Where Y is the numerical value.

(2) The differences between these three methods may be understood from this example: Assume the scale maximum is 100 and the accuracy is ± 2 per cent.

. . . ± 2 per cent of actual reading —If the actual value is 100, the reading may be from 98 to 102 and if the actual value is 10, the reading may be from 9.8 to 10.2.

. . . ± 2 per cent of full scale—If the actual value is 100, the reading may be from 98 to 102, *but* if the actual value is 10, the reading may be 8 to 12. Thus at an actual value of 10, the error is ± 20 per cent, not ± 2 per cent.

. . . ± 2 per cent of average error —With this method the meter reading is the average of two readings taken during calibration one reading is taken with the meter approaching the test point from a lower reading, the other reading taken with the meter approaching the test point from a higher reading.

If the actual value is 10, the first reading might be 9.6 and the second 10.8, or the first might be 9.2 and the second 10.4. In the first case the average is 10.2, in the second the average is 9.8. The "average error" is 2 per cent in both cases, although the individual observations are in error by several times 2 per cent.

C . . . Control

1. Basic Considerations

a. Control is applied to:

(1) Flow rates in main lines, raw supply transmission mains, filter influent, filter effluent, and filter wash water.

(2) Levels in reservoirs, storage tanks, settling basins and wells.

(3) Pressure in distribution system.

(4) Pump operations.

(5) Chemical feed rate and dosage.

(6) Filter operation.

(7) Filter washing cycles.

(8) Chemical characteristics of water.

(9) Temperature and humidity of plant atmosphere.

b. The elements of a control system consist of:

(1) Sensing device—a unit which ascertains the condition existing.

(2) Transmission system—a system which conveys the information sensed to some desired point or to the control device.

(3) Control device—a unit which is actuated by the transmitted information to produce the desired control; it may be a switch, valve, or positioning device.

(4) Instrument—a device which totalizes, indicates, or records the condition existing at the sensing unit and thus shows the extent of control effected.

(5) Sentinel alarm—a device which warns an operator that an undesirable condition exists at the sensing element or that the desired control has not been effected.

(6) Feed back—a basic mechanism of self regulating automatic systems. It has, as yet, found little application in water works, but it has potential uses.

(7) Control panel—a unit in which are located primary control devices (such as starter buttons, etc.) and instruments; usually placed in a central location to aid in operation and supervision.

c. Degrees of control obtainable are:

(1) Manual control—The simplest control possible is that initiated by an individual operator, wherein he initiates the actual control by starting or stopping an operation, or varying the rate of an operation or process, based on observation, tests, indicated condition.

(2) Semi-automatic Control—The operation of a secondary device, machine, or process is interconnected with a primary unit, device or machine so that the secondary unit operates at a fixed rate in conjunction with operation of the primary unit or influenced by a change in a measured variable.

. . . This is simply automatic start-stop operation of a secondary unit with start-stop operation of the primary unit; or in response to some measured variable.

. . . *Step-control* is a form of semi-automatic control, in which the secondary device is stepped up in operation rate, in definite increments as the operation of the primary device is increased by definite increments of output; e.g., when several pumps come on the line in sequence a chemical feeder output will be increased in step-wise delivery quantities to meet the need for increased chemical requirement.

(3) Program control — The start-stop and rate of operation of a device, machine or process is controlled according to some predetermined pattern or program with respect to time. This is sometimes termed time-cycle control, particularly if operations are started or stopped in response to some predetermined time relationship. (Fig. 7.)

(4) Proportional pacing—The rate of operation of a secondary device, machine or process is controlled by and responds directly and proportionally to the rate of operation of a primary device or machine or to the variation in a measured variable.

(5) Combination control — It is possible to combine manual semi-automatic proportional pacing systems in order to obtain desired relations between manual adjustments, start-stop operation, and rate of operation.

(6) Automatic control — This is automatic self regulation of operation by means of feed back. Sometimes termed automation, automatic control uses the results of some operation to control that operation at the desired rate. It is subject to manual start-stop or to automatic stop if a malfunction or misfunction occurs and to automatic start when the malfunction or misfunction is corrected.

2. Rate of Flow Control

a. Main line flow.

(1) The sensing device may be any differential producer.

(2) Transmission may be mechanical, electric (e.g., Chronoflo Telemeter) or pneumatic.

(3) The control device may be one or more fixed or variable speed pumps; valves, gates, etc. (for example a butterfly valve operated hydraulically, electrically or pneumatically).

b. Filter rate control.

(1) The sensing unit is a special differential pressure actuated controller called a filter effluent rate controller (Fig. 8). It responds to change in loss of head in the filter. As the loss of head increases, the rate controller opens up proportionately to maintain a constant flow rate through the filter. (Figs. 9 and 10 show installations of rate controllers.)

(2) Filter effluent rate controllers may be self powered direct-acting, pneumatic or hydraulic-cylinder-operated. The latter can be constructed to be tight closing, in which case the effluent valve can be eliminated.

(3) These rate controllers can be arranged to start from a closed position and they can be arranged to remain closed when the filter effluent valve is closed and open automatically when the effluent valve is opened.

c. Filter wash rate:

(1) Wash water controllers for controlling the rate of rise of back wash water (and hence sand expansion) are similar to filter effluent controllers in design, control principle and operation.

(2) Construction of these controllers is heavier than filter-rate controllers because of higher line pressures and high pressure losses.

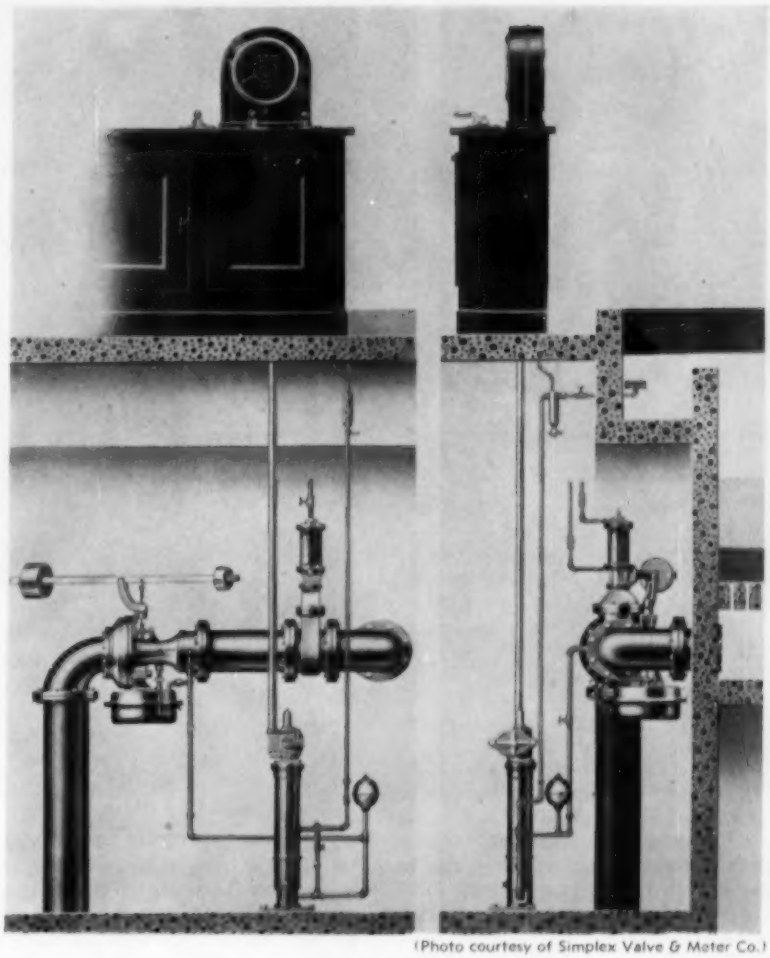
3. Plant Control

a. Control of all filters in a plant can be effected in three ways: (1) Throttling (modulation) or instantaneous shut-off by changes in clear well level, sensed by a float, (2) changes in influent level, and (3) control of raw water flow from clear well level. Combinations of these types of plant controls may be used where needed to suit particular conditions.

b. Filter operations: in-out of service and backwashing are controlled from filter operating tables which are manually operated to open or close valves hydraulically (Fig. 11). Filter tables are strategically placed on the filter operating floor (see Fig. 12).

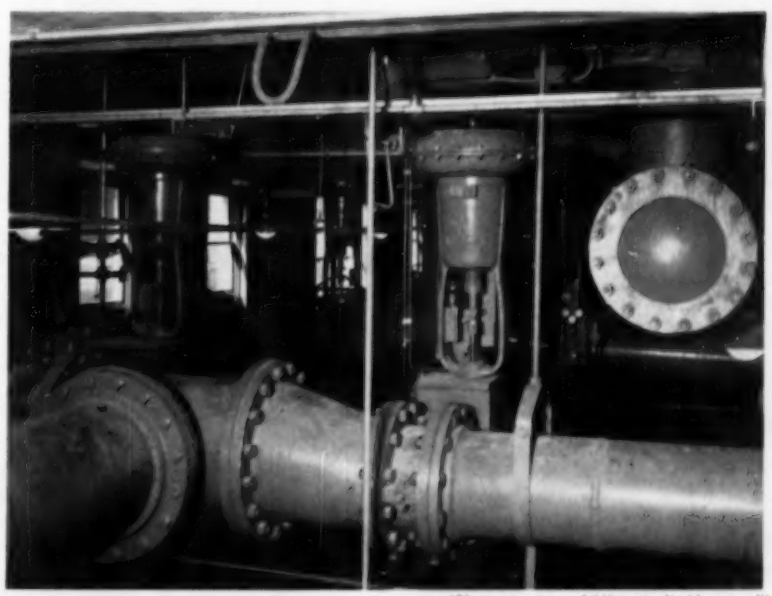
c. Control of filter backwashing can be done with a control system known as Auto-Central control. (Fig. 13.)

(1) Combined manual-program-semi-automatic. When an operator decides a certain filter needs washing, a "filter selector" on the control panel



(Photo courtesy of Simplex Valve & Meter Co.)

Fig. 9—FILTER rate controller installation



(Photo courtesy of Minneapolis-Honeywell)

Fig. 10—FILTER rate controller installation

(Photo courtesy of Simplex Valve & Meter Co.)

Fig. 11—FILTER operating tables

Fig. 12—FILTER operating gallery at Allentown, Pa.

is turned to that filter number, and the start button is pressed.

... The controls then automatically close the influent valve and effluent valves, open the drain and wash water valve, in sequence. Then a back wash timer provides variable duration and intensity of back wash rates. At the completion of back washing the valves are repositioned for filtering service.

(2) Timed-cycle program—The "automatic" washing can be set on an elapsed time period basis.

(3) Automatic operation — Complete automatic backwashing can be initiated by excess loss of head, independent of time or manual observations.

(4) Valve controls are provided so that complete manual control of filter operation is possible.

4. Level Control.

a. The sensing elements used are the same as those used for indicating or recording liquid level: floats, diaphragm bulb and bubble pipe.

(1) Transmission from float is direct by cable or pneumatic or electric through respective type of transmitter. (Fig. 15.)

(2) Transmission from a bubble pipe is direct air pressure to the receiving device. Air flow to the submerged tube is regulated by a constant differential relay, with the rate indicated by a Rotameter. Changes in liquid level are reflected in changes in the air pressure. Air consumption is about 2 cfh.

(3) Transmission from diaphragm bulb is direct pressure through a small copper tube to the receiver or control device. This system is applicable to depths up to 100 ft. Transmission is limited to 40 ft for a level change of 100 ft and to 300 ft for a level change of 30 ft.

b. Level control is applied to raw water supply or distribution reservoirs, as well as clear well basins.

c. The control device may be a positioned valve or a controlled pump.

5. Pressure Control.

a. The sensing elements used are the same as those used for indicating or recording pressure: Bourdon tube, bellows, diaphragm bulb or bubble pipe.

b. Transmission may be either direct hydrostatic pressure, pneumatic or electrical through respective transmitters.

c. Pressure control is applied to distribution systems including elevated storage tanks and to filter wash water tanks.

d. The control device is some mechanism which controls pump operation.

6. Pump Control.

a. Pump control may fall into one of four categories, depending on the actuating factors involved in operation.

(1) Pressure.
(2) Level.
(3) Time Cycle.
(4) Flow.
(5) Pressure-flow.

b. Pressure Control.

(1) Simplest form is a pressure switch in a pump discharge line. The switch is adjusted to close the pump motor circuit whenever line pressure falls below a minimum value.

... This system is similar to domestic water supply installation in which water is pumped from source into a pressure tank. When this is filled, the pump shuts off and supply is obtained from the tank reserve until the pressure falls below the minimum desired value.

... The tank is usually partially filled with air to act as a cushion which compresses and expands to maintain pressure within the desired range.

(2) The switch is equipped with a differential pressure adjustment. The contact is made to open when the pressure reaches an allowable maximum and thus cut off the pump. When the pressure drops to the lower point of the set differential, contact is made to close and the pump starts.

... A time-delay device may be used to prevent a unit from starting until a period of time has elapsed after which the pump will start if the pressure remains low.

(3) This method of pump control is used for booster pumps supplying elevated storage tanks. (Fig. 14.)

... If there are many drawoffs between the pump and elevated tank, compensation must be made for the pressure drop in the line. This can be done by telemetering the condition at the tank directly back to the pump.

c. Level control.

(1) Where suction is from ground level storage and discharge is into elevated storage or closed section of distribution system, control from liquid level in the elevated tank telemetered back to the pump is better than pressure control.

(Photo courtesy of Builders-Providence, Inc.)

Fig. 13—AUTO-CENTRAL filter control system

. . . Any number of pumping units can be controlled and started in sequence at predetermined levels during falling levels and stopped in sequence at predetermined rising levels. (Fig. 14.)

(2) Type of level controls depends on distance from storage tank to pump.

. . . For short distances, use any type of sensing unit: simple float switch, electronic or resistance probes, bubble pipe, or diaphragm bell operated indicators.

. . . For long distances, use electric transmitters to telemeter the sensed level to the pump.

d. Time-Cycle Control.

(1) Pumps are started or stopped according to some predetermined time relationship.

. . . Adjustments are provided for changing the cycle for seasonal or weekly variations.

(2) Time-cycle control is frequently combined with some simple pressure control to provide for unusual conditions of low suction head or extreme fire flows.

e. Flow control.

(1) This system combines a differential pressure producer to measure flow and a suitable mechanism to initiate or control operation of pumps.

(2) As flow demands increase or decrease pumps cut in or out as needed.

f. Pressure-Flow Control.

(1) This system combines measurements of both pressure and flow to control the operation of one or more pumps whose speeds may be fixed or variable.

(2) The pressure-flow method invented by Marsden C. Smith of Richmond, Va., is marketed under the trade mark, "Pressureflo."

(3) The sensing units are a flow measuring device (Venturi tube, Dall flow tube, etc.) and a pressure sensing device.

. . . Either a single meter may be used for one or more pumps or several meters may be used for individual pump discharges; in the latter case, the flows are summed for control purposes.

(4) The control is initiated by a low pressure switch on the discharge line or a minimum level contact in a reservoir or tank level gage.

. . . Pumps operate thereafter under control of the flow demand as long as the flow remains above a predetermined minimum and the pressure below a predetermined maximum.

. . . More pumps may cut in or out based on additional flow and pressure zone contacts. For close control the pumps should be variable speed.

. . . When pump operation is no longer required, both flow and pressure contacts open and stop operation.

(5) The pressure-flow method can be installed in old or new plants. This control system is suited to single or multiple pumps of fixed or variable speed, especially in direct pressure systems. The system may be applied to ground storage or elevated storage distribution systems and will provide immediate response to peak demands.

7. Chemical Feed Control.

a. Chemicals are added to water at rates necessary to produce the desired reactions, that is, at rates necessary to produce the concentration required of the chemical in the water undergoing treatment. These concentrations of chemicals are expressed in terms of parts per million, or more commonly as dosage rates in pounds per million gallons.

b. Control of the chemical feed rate can be performed by any of the degrees of control desired; manual,

(Photo courtesy Automatic Control Co.)

Fig. 14—PUMP CONTROL robot and indicator panel

semi-automatic, step, program and proportional pacing.

c. Dosage rates can be controlled manually, by program, or by fully automatic feed back systems in some cases.

d. Dry chemical feeders, whether volumetric or gravimetric are adjustable to feed chemicals over a range of rates per unit time, usually expressed as pounds per hour, or pounds per 24 hours.

(1) In manual control, the operator starts and stops and adjusts the feeder to add the desired number of pounds of chemical per hour or day during which time a known quantity of water or rate of flow is to be treated.

. . . If the flow rate changes, the operator must adjust the chemical feed rate accordingly.

(2) In semi-automatic operation, the feeder will start and stop with flow start and stop, or will increase in or decrease in predetermined steps if the flow increases or decreases by predetermined steps, as with adding another pump to the line.

(3) In program control, the feed rate automatically changes in pounds per unit time in accord with some predetermined time cycle.

(4) In proportional pacing control, the chemical dosage rate per million gallons is manually set according to the operator's desires, and this rate will be maintained in accord with any changes in flow. That is, the feeder will be paced proportionately to the flow and the rate of feed per hour will vary in order to maintain the preset dosage rate per million gallons.

d. Chemical feeders for liquid chemicals or chemical solutions are designed to discharge adjustable volumes per cycle of operation.

(1) In order to vary chemical dosages, the volume discharge or the cycles of operation per unit time can be controlled.

(2) Volume of discharge and operation cycle of the feeder can be controlled manually although manual cycle control is usually of special design.

(3) The rate of operations of the feeder can be controlled in steps, on a program, or proportionately paced from a flow measuring device.

e. Chlorine gas feeders are designed to feed chlorine gas at rates calibrated in pounds per 24 hours. They can be controlled by any of the systems mentioned; manual, semi-automatic, program, or proportional pacing.

f. Fully automatic control of chemical feeding in water treatment is possible.

(1) Adjustment of pH, by lime can be controlled from a continuous determination of the resultant pH. Chlorine feed can be controlled from oxidation-reduction potential controllers.

(2) Experimental work and new equipment development may be expected to produce additional chemical dosage controls.

. . . Control of coagulant dosage from turbidity measurements.

. . . Control of chlorine dosage from continuous residual chlorine determinations.

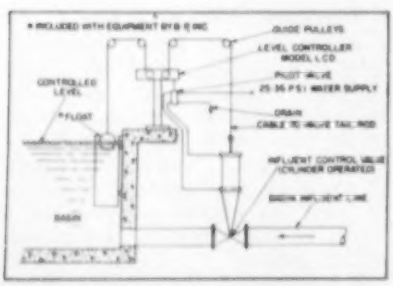


Fig. 15—DIAGRAM of basin level control

8. Temperature and Humidity Control

a. Temperature control is accomplished through a thermometer sensing unit, usually a bimetallic thermocouple which makes or breaks a contact in a circuit that operates the heating (or cooling) device.

b. Humidity control is particularly applicable in filter galleries and can be accomplished through the use of a recording hygrometer which is connected with the operating switch of a dehumidifier.

9. Supervisory Control

a. Supervisory control is a system which enables an operator to control any combination of remote pumps, valves, chemical feeders or other electrically operated devices from a central dispatching station.

b. Supervisory control is used in the control of low service pumps, deep well pumps at well fields, main pumping stations, or booster pump stations.

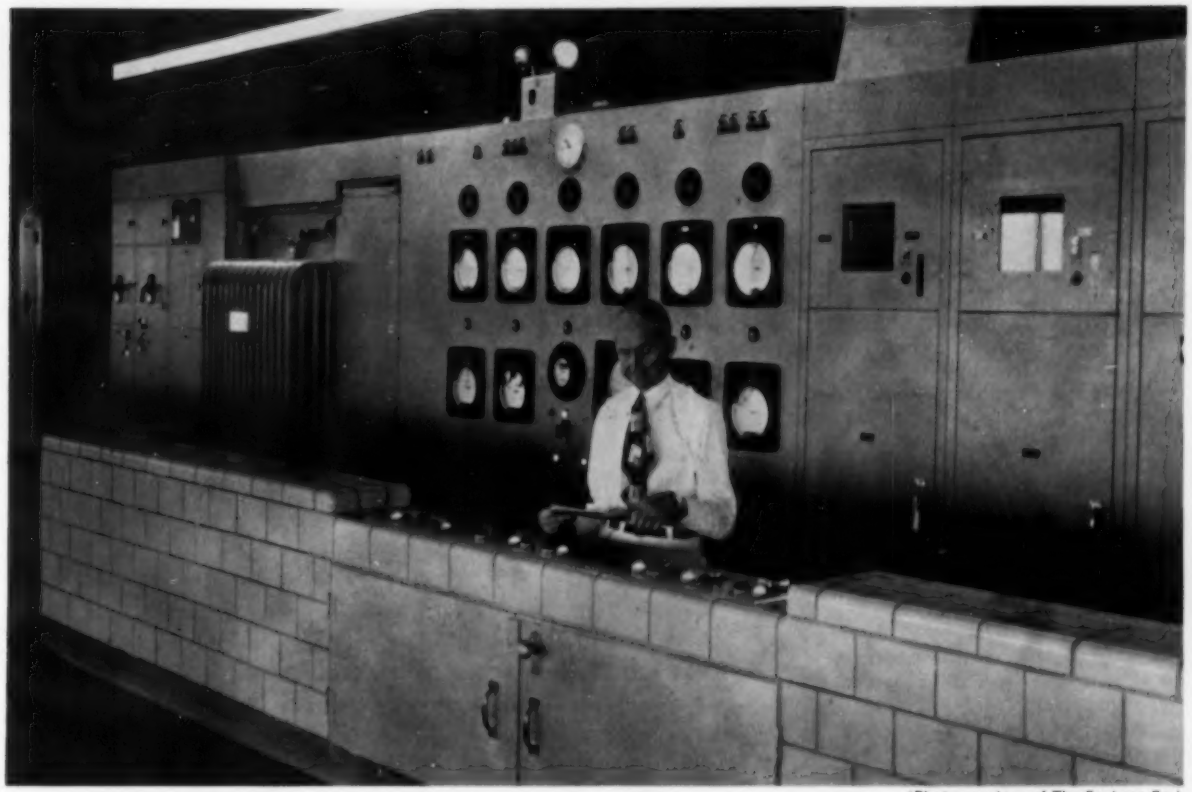
c. The dispatching station or control center may be located in a filter

Correction

Mr. Robt. S. McCaffery, of Garvens U.S.A. Inc., has called attention to the need for clarification in the lecture on "Pumps—Application and Operation."

In section 3(e) on deep well submersible pumps (p. 529, Dec. 1954), the description is given of a Byron-Jackson mercury seal submersible pump, which are built in large integral sizes only, but Figure 1 shows the cross-section of a Garvens six-inch pump which is *not* a mercury seal pump.

The text should have pointed out that there are three basic types of submersible pumps in use: (1) Completely oil filled type of motor (Byron Jackson) which requires some type of seal and a pressure equalizing or balancing device; (2) A completely sealed type stator with the rotor running in the water (Garvens), used in the smaller sizes; (3) The wet motor which actually has its windings in the water; it is closer to the conventional type of motor but requires extra heavy insulation on the windings.



(Photo courtesy of The Foxboro Co.)

Fig. 16—CENTRAL CONTROL panel of instruments and control table

plant, main pump station or superintendent's office.

d. One or more of the following results may be obtained:

(1) Select remote control unit.

(2) Start-stop of pumps or other device.

(3) Report back of operating condition of the pump or other device.

(4) Signal faulty or interrupted controlled unit operation; indicate signal line current continuously and open or short circuit condition.

(5) Reset equipment for next operation.

(6) Telemeter additional information on pressure, flow, level, temperature, gate or valve position, flow direction, etc.

e. One system of multifunction supervisory control is marketed under the trade name, Synchro-Scan. In this system, any of the results conditions, or operation indicated under (d) above are readily obtained. This system can utilize any of the following systems of transmission: Private wires, leased telephone lines, modulated carrier frequency, audio tone channels, or microwave link.

10. CONTROL PANELS

a. Flow meter instruments, loss of head gages, filter controls and instruments, pump controls, chemical feeder controls when mounted in one central location constitutes a control panel. (Fig. 16.)

b. Control panels can be arranged to include lights and a mimic diagram of piping and valve layouts or pumps or other devices. Thus it is possible for the operator to see, at a glance, the operating condition of a plant.

D . . . References

Material for this lecture was based in part on technical literature and bulletins on the subject published by manufacturers of instrumentation and control equipment.

NEXT LECTURE: Chemical Handling and Feeding.

W&SW

Murdoch and Geehan Elected Vice Presidents of the American Water Works Co.

Mr. Murdoch has served as Director and Vice President of The Citizens Water Co. of Washington, Pa. He joined the Community Water Service Co. in 1924 when that Company acquired The Citizens Water Co. In 1936, when Community Water Service was absorbed by American Water Works Electric Co. Inc., Mr. Murdoch became attorney for the latter. He has served as Chief Counsel for American Water Works Service Company, Inc. since 1947.

Mr. Geehan joined the Operating Department of American Water Works and Electric Company, Inc. in 1917. He has served as Division Manager and President of a group of subsidiary companies of American Water Works and Electric Company. Since 1949 he has been Chief Division Manager of all of the water companies owned and controlled by American Water Works Company, Inc. and Northeastern Water Company.

W&SW

SCHUYLKILL RIVER SURVEY—Collecting specimens to evaluate plant and animal life

Research on Recovery

As the Schuylkill River returns to normal, the Philadelphia Academy of Natural Sciences is making a continuing study of ecological factors under sponsorship of the Committee on Water Pollution Abatement of the MCA

THE PROBLEMS of stream pollution in the chemical industry are of vital concern to the Manufacturing Chemists' Association. In 1937 the Association organized a Water Pollution Abatement Committee as its working committee on this problem.

Development of the Project: Statement by Mr. Dickerson

The Water Pollution Abatement Committee was established with three basic principles in mind:

1. To acquaint the industry with the nature of stream pollution.
2. To assist member companies to organize for sound and effective abatement programs.
3. To provide an opportunity for the exchange of technical information on waste treatment.

These functions are being carried out by means of:

I. Industry Conferences held about once each year. The conferences have given excellent coverage to developments in waste treatment, pollution abatement and legislation enacted in the several states.

II. Manuals published to cover the organization and method for investigating wastes and the problems arising, together with general principles for treating various classes of industrial wastes.

III. Representation on National Industry Committees, such as the National Technical Task Committee for Industrial Wastes, where the views of the chemical industry are expressed and progress in pollution abatement is outlined.

Academy of Natural Sciences Stream Research Program

IV. Research programs which are being carried out at the Philadelphia Academy of Natural Sciences. These programs will develop basic research which will be of valve to all in stream pollution abatement work.

They cover: (1) the manner of recovery of streams after pollution is removed; (2) sensitivity of fish at several stages of development to various chemical and physical factors; and (3) studies on growth and distribution of the diatoms so necessary in providing satisfactory conditions in healthy streams.

It is the first of these programs which Dr. Patrick will discuss and which we believe will mean much to the sanitary engineering profession in determining the recovery of previously polluted streams. The criteria which she will develop will provide tools for evaluation of the watercourse and a method for estimating its time of recovery.

In further line with the basis principles originally outlined, the MCA committee is promoting regional water pollution abatement workshops which will be held at a number of locations around the country in order to provide more technical assistance to plant personnel in their specific water pollution problems. We believe such programs will be of real value and will assist the chemical industry in its lead in pollution abatement.

Schuylkill River Recovery Studies: Statement by Dr. Patrick

The Schuylkill River probably is one of the most widely publicized rivers in the country. It was named by a Dutchman, Arendt Corssen Leyden, who called it Skokil—which means "hidden river."

In the 19th century the Schuylkill was the playground of Philadelphia. Boating and fishing were favorite sports. To the scientist it was a treasure house of plants and animals. Joseph Leidy described several species new to science which he found in its waters. Likewise T. Chalkey Palmer and Charles Boyer described many new aquatic plants discovered there.

But at the close of the century all of this started to change. The mines and industries began to use the river more and more for waste disposal. A river has a great ability to cleanse itself, that is, to destroy the wastes that enter it. But if the pollution load is too great this ability is destroyed, and the river becomes more and more polluted. So it was with the Schuyl-

RIVER RECOVERY—Factors are aquatic life, chemical composition, and bacteria.

# of a Polluted River

by B. W. DICKERSON
Chairman, MCA Water Pollution Abatement Committee
San. Engr., Hercules Powder Co., Wilmington, Del.
and DR. RUTH PATRICK
Curator of Limnology, Academy of Natural Sciences, Philadelphia, Pa.

kill. The waters of the river became black and murky, and plant and animal life became scarcer and scarcer. The river bed became filled with silt and debris.

The philosophy of waste disposal at that time was "the Schuylkill is so bad a little more pollution won't hurt."

It was then that the state and federal government stepped in. The Schuylkill River had to be cleaned up. The Sanitary Water Board of Pennsylvania is to be commended for the fine work it has done in forcing industry to reduce and treat its wastes.

Once again the Schuylkill is fairly clear. The bottom, although still soft, is suitable for aquatic life. When the organisms are established, they will help to bring the river back to normal conditions. Hardly had the Schuylkill started to improve physically but certain of the more tolerant plants and animals started to reappear in the lower reaches. This condition was most evident in the late summer and fall of 1954.

Plant and Animal Life In River Recovery

The Schuylkill offers a wonderful opportunity to study the "comeback" of a river. The Limnology Department of the Academy of Natural Sciences of Philadelphia has as the main object of its research program reaching an understanding of the fundamental ecological factors governing the plant and animal life in a natural river. This involves, among other things, understanding just how a river "cleanses itself"—and how this process is modified by ecological factors.

So far as we know, this is the first time a group of scientists has had the opportunity to undertake a continuing study of the succession of recovery in selected areas of a previously polluted river.

It is true that the course of recovery as water moves downstream has been studied, but just what is the succession in aquatic life at a given point in a stream returning from polluted to normal conditions no one knows.

From a cursory study of the Schuylkill River in its flow between Conshohocken to Fairmount Dam only the most tolerant species were present. By studying the same area over a number of years, we will be able to determine the succession of plants and animals, and also what happens to the chemical composition of the water and its bacterial content.

The next step will be to determine how this process of recovery can be hastened. Such knowledge should be of great value to industry and municipalities when they wish to bring back a river as quickly as possible once a mishap has occurred.

This program is very similar to what has been done in developing reforestration programs. First, those involved had to learn what was the natural succession. In our reforestration programs, we now follow this natural succession; i.e., pines are planted before hardwood.

We are very grateful to the Manufacturing Chemists' Association for making this study possible. The Association has opened a new door leading to our understanding of river conservation.

The importance of river conservation hardly needs to be emphasized. The average person now uses approximately 8 times the amount of water he used at the turn of the century. Besides this is the great expansion in water use by industry. Thus, while the use of water is expanding at a rapid rate, the amount of water falling on the earth is the same as before our civilization began. Most of the water which we use is surface water, water which is held in our lakes and flows through our rivers. If we are to have adequate water supplies for civilization in the future, it is self-evident that these water arteries must be kept in good condition. The plant and animal life must function normally so that their power of "self-cleansing" can be maintained. In this way we can have use without abuse of our waterways.

VACUUM FILTERS—Illustrated are less than half of the 98 units comprising this installation

How to Select and Care For

by WARREN L. SHEDDEN

Mr. Shedden is Asst. Mech. Engr., West-Southwest Sewage Treatment Plant, Chicago, Ill. For nine years, he has been responsible for operation of the large installation of vacuum filters at this plant. His report provides much useful and valuable information based on extensive studies.

IN A SEWAGE disposal plant where sludge is dewatered to produce filter cake for further drying, the filter room may be considered the heart of the plant. Years of study and endless trials are required to establish methods of sludge conditioning so that a continuous production of filter cake can be maintained.

In the filter room characteristics of the incoming concentrated sludge are closely observed and noted. Conditioning treatment is altered as required to maintain a constant level of filter cake for efficient plant operation and for dried sludge (fertilizer) production.

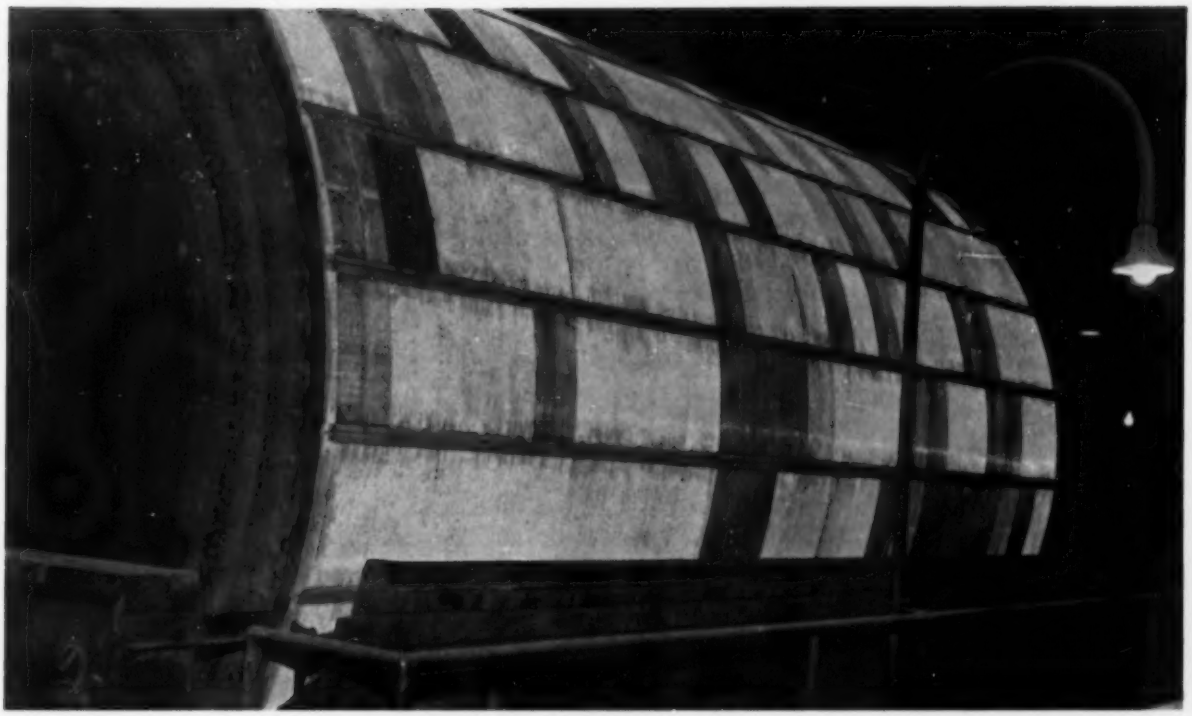
At the West-Southwest Sewage Treatment Plant of the Sanitary District of Chicago, excess sludge from the activated sludge sewage treatment process is first filtered on vacuum filters, and then is dried by flash dryers and is disposed of in bulk as a fertilizer base. The original plant design contemplated filtration, drying and incineration of sludge from both preliminary settling units and secondary clarifiers. Difficulties in the sludge drying system, caused by the high grease content of the preliminary sludge, after about seven months of operation led to adoption of the present method of disposal.

Filter Installation Grows from 24 to 98 Units

Originally twenty-four filters 11 ft. 6 in. in diameter by 16 ft. in length were provided. These were arranged in eight rows of three filters each. Each line of filters discharged to a rubber belt carrying the filter cake to a drying system. In 1940, after about a year of operation, another filter was added to each row.

During 1953, three additional filters were added to each of the original lines, and six new lines of filters (seven filters in each) were installed. This installation brought the total number of filters to ninety-eight. The new facilities were available for service in November, 1953.

Ferric chloride is used to condition the sludge. By conditioning, the sludge is concentrated from about 0.8 per cent solids (as wasted from the final settling tanks) to 1.2 to 2.0 per cent solids (as delivered to the filter room). The pH range of the treated sludge is approximately 3.0 to 4.0, varying somewhat with the volatile matter content of the sludge. The pH of the conditioned sludge varies inversely with the quantity of ferric chloride required to properly condition the sludge. *It is essential that the sludge be properly conditioned in order that the blankets can efficiently produce the desired filter cake.*



BLANKET SUPPORTS—Now used are plastic backing grids, end-sealed by stainless steel ribbon

Sewage Sludge Filter Blankets

Filter Blankets Are Important

The capacity of a sludge drying system is largely determined by the moisture content of the filter cake delivered to it. Accordingly, one of the most important factors in vacuum filter operation and cake production is the selection, installation and care of the filter blankets. Filter blankets serve the purpose of removing liquid from the sludge solids, to produce a filter cake for further drying. This plant has endeavored to obtain the best possible filter cloths for its use. To that end, extensive studies have been made of all factors, including use of different kinds of blankets and methods of installation, treatment and maintenance. The original filter blankets were napped wool twill, weighing 12 ounces per square yard of material. They were stretched tightly over ¼-in. mesh 16 gauge monel metal screening which was fastened on wood grids nailed to the decking. Twelve gauge copper or copper alloy wire was spirally wound around the drums using two-inch spacing. The cake was removed, after blowback, by a heavy steel scraper blade. The blade was welded to the apron of the filter unit and was pulled tightly against the winding wires.

The maintenance on this system of cloth mounting was high, because of corrosion, wearing and breaking of the winding wires, and through corrosion of the monel screen. The unavailability of monel metal screen brought about the substitution of wood for backing grids, which provided drainage and served as support for the filter cloth.

Wood Supports for Blankets

The face of the wood grids was ribbed on ⅜-inch centers, with a groove depth of ¼-inch. The back of the grids was cut to provide drainage channels, directioned both laterally and circumferencially. Communication with the face of the grid was accomplished by wide saw cuts (approximately ⅛-inch), running in a horizontal direction, and deep enough to reach the grooves of the face. These cuts also served to accommodate the sections to the curvature of the filter drum.

The wood sections were of a length to fit between the separator strips which divide the circumference of the drum into twenty-four sections of approximately twenty inches each. The ribbing was set at an 18-degree angle to the separator strips, in order to keep the winding wire out of the backing grooves.

With restrictions on the use of strategic metals during the last war, it became apparent that an insufficient supply of copper wire would hamper operations. Experiments were made to fasten the cloth to the separator strips. This was first accomplished by grooving the separator strips and holding the cloth in place with nailed wood strips which forced a tight fit of the cloth in the groove. A shoulder cut into the backing around each end of the filter allowed similar end fastening of the cloth.

A Stainless Steel Scraper and Plastic Panels

The scraper blade was then held against the cloth only by a weighted bar at each end; its travel was limited by set screws, to insure its clearing the retaining strips at the panel separators. Somewhat later, an 8-inch strip of 22-gauge stainless steel was bolted to the apron with a five-inch extension. This strip was used in place of the stiff steel scraper blade.

TABLE 1
Comparative Rating of Vacuum Filter Blanket Materials

Material	Installation Rating	Initial Cake Pickup	Cake Production	Elongation Tendency	Water Wash Response	Detergent Wash Resp.	Acid Wash Resp.	Scraper Abrasion Resistance	Useful Life (Hrs. of Service)	Economic Rating
Wool 12 ozs.	Difficult	Poor	Fair	Too Much	Good	Good	Good	Poor	1900	
Wool 13 ozs.	Difficult	Fair	Fair	Too Much	Good	Good	Good	Fair	2400	
Wool 14-15 ozs.	Easy	Very Good	Very Good	Much	Good	Good	Good	Good	2700	4
Wool 16 ozs.	Difficult	Fair	Fair	Much	Good	Good	Good	Good	1600	
Wool Treated 14-15 oz.	Easy	Very Good	Very Good	Some Varied	Very Good	Very Good	Very Good	Good	3300	3
Vinyon	Very Difficult	Fair	Fair	Too Much	Fair	Poor	Poor	Poor	1000	
Nylon 100%	Very Difficult	Fair	Fair	Much	Fair	Fair	Very Poor	Good	800-7600	
Nylon 90% Saran 10%	Very Difficult	Fair	Fair	Much	Fair	Fair	Poor	Good	3000	
Nylon 25% Wool 75%	Easy	Good	Fair	Some	Good	Good	Poor	Good	3300	
Dynel 50% Wool 50%	Easy	Good	Good	Some	Good	Good	Good	Good	3700	
Orlon 100%	Difficult	Fair	Good	Some	Good	Fair	Poor	Fair	2000	
Dynel 100%	Difficult	Poor	Good	Some	Good	Good	Good	Fair	Over 4000	2
Dacron 100%	Easy	Very Good	Very Good	None	Very Good	Very Good	Very Good	Very Good	Over 11,000	1

The set screws to adjust the floating arrangement were continued. Present replacements are made of 16-gauge stainless steel, which has longer life, holds alignment better, and exhibits less tendency to sharpen at the scraping edge.

Injection-molded polyvinyl chloride plastic panels are now used for backing grids, with the ribs vertical to the separator strips. The cloth is held in place by acid-resistant cord driven into dovetail mortises cut in the separator strips. The ends of the panels are sealed by tightly drawn stainless steel ribbons, nailed at intervals to prevent slipping.

In addition to the savings in materials, our present panel fastening has resulted in reduction of time required to replace blankets and make repairs. The response of the blankets to water wash and to detergent wash has been improved, and the cleaning of the backing at the time of cloth changing is much easier.

The change from wire winding to panel fastening of the filter cloth accelerated our studies of filter blankets. With support every two inches by the winding, little ballooning effect was possible at the time of the blowback; however, a certain amount was desirable to effect contact of the scraper blade with the filter cloth for proper cake removal. Abrasion effect was a much smaller factor.

With the panel fastening, an area of wet cloth approximately twenty inches in one direction and sixteen feet in the other, was exposed to the blowback air pressure. There was evidence of excessive elongation of the cloth in both directions. One remedy lay in reducing the blowback air pressure from eight pounds to two or three pounds per square inch; at the same time, cloth with lower elongation propensity was sought. Studies showed the larger benefit would be derived from an increase in the number of twists given the threads used, and from a slightly closer weave, resulting in a slightly heavier cloth.

Installing Filter Blankets

In our studies of filter cloths, we made it a practice to give no special care to any cloth during the program, since it was necessary to discover its value for use under ordinary operating conditions. In making the installation, cloths are fitted snugly to the filter drum, with tension maintained as evenly as possible. A dark colored woof thread woven into the cloth at about four feet intervals (as measured along the warp) greatly aids in aligning the blanket. The degree of tension required varies with the material and the weave of cloth, to allow for differences in stretch while in service.

The blankets as purchased are about 16 inches longer and six inches wider than the actual measurements of the drum, to make installation easier. The trimmings are used for patching cloths torn in operation.

Detergent Wash

After installation, the blanket is given a detergent wash to thoroughly wet and flex the fibres. For the detergent wash we add two quarts of 60 per cent active triethanol amine alkylaryl sulphonate, to about three hundred gallons of water in the filter pan. The drum is rotated for four hours with the agitator in operation; this provides a foamy suds washing action, cleaning out most of the accumulation of solids, greases and fungi which cause blanket blinding. A plain water rinse follows, using the jet sprays mounted at the rear of the filter.

During filter operation, the cloths

become loaded with sludge solids, grease and iron oxide. In warm weather there also are fungus growths from the conditioned sludge which cause blinded areas on the filter blanket. Each filter is water-washed after a forty-eight hour period of service. When this washing fails to clean the filter satisfactorily, detergent wash, as previously described, is used. Detergent wash usually will remove solids, grease and fungus, but will not affect iron oxide deposits.

Acid Wash

If unsatisfactory cake pickup indicates excessive iron oxide clogging, the cloth is washed with 18° Beaumé inhibited muriatic acid, which is dripped on the blanket at the top of the slowly revolving drum. Approximately twelve gallons of acid are applied.

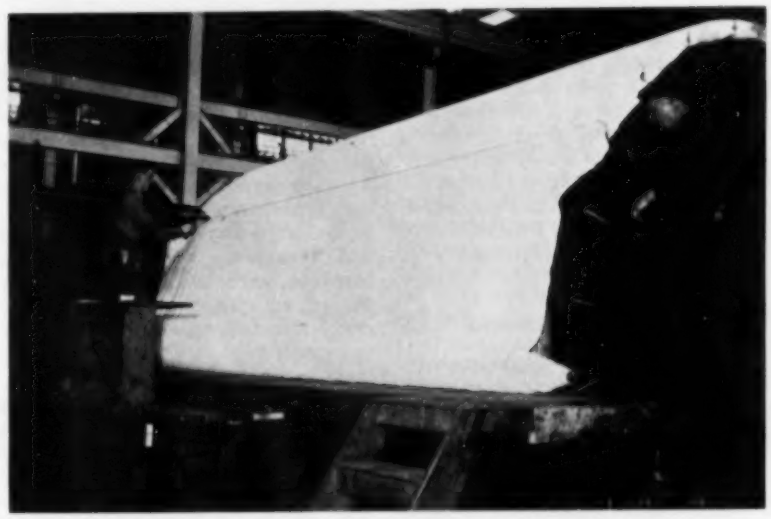
The acid is allowed to remain in the blanket for about eight hours, with the filter drum revolving continuously. The filter blanket is then sprayed with water for about an hour before the filter unit is returned to service. When less than 75 per cent of the area of the blanket fails to produce filter cake, it is marked for replacement.

Service, Record and Testing

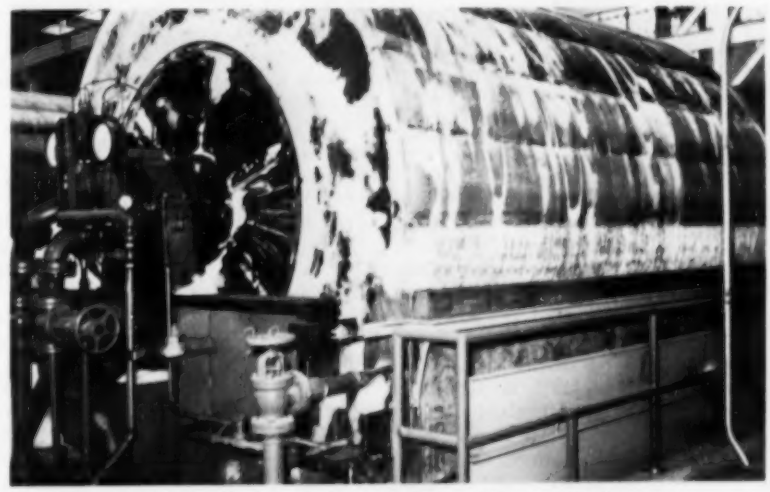
A complete record is maintained for all blankets, showing information such as purchase contract, manufacturer, date received, blanket number, date installed, kind of material, weave, weight, pressure loss, wash and maintenance record, hours of service, date and reason for replacement.

A sample of each blanket, as installed, is filed for possible future reference, and a second sample is sent to the laboratory for testing. There it is examined for conformity to specifications, including pressure loss, which is measured in inches of water at an air flow of 150 cu. ft. per minute per sq. ft. of blanket area. This standard was adopted instead of the A.S.T.M. designation D 461-47 (which defines permeability as the quantity of air passed in cu. ft. per minute per sq. ft. at 0.5 inch pressure loss), since it was found that the slope of the curve plotting pressure loss against air flow varied among the different types of materials.

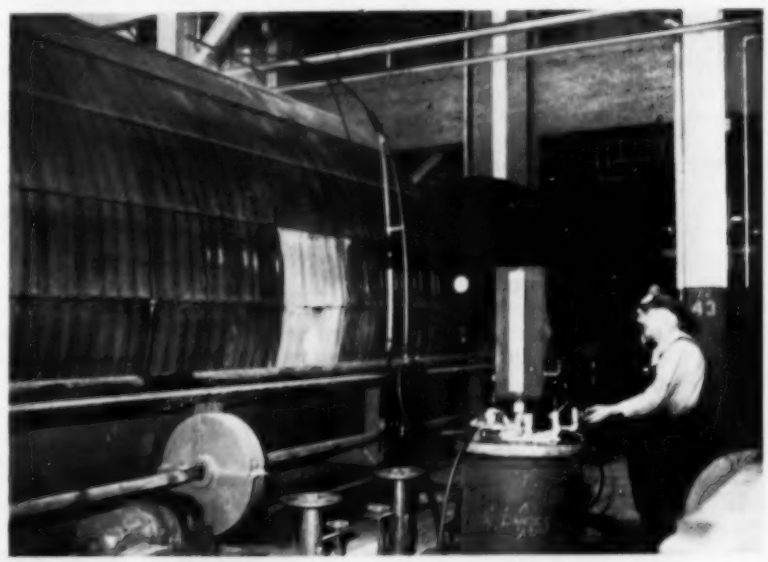
The sanitary district's testing equipment consists of a source of low pressure air, a plenum chamber having a circular opening of 0.1 sq. ft. area, a zero to 2.0 inches inclined



INSTALLATION—Acid-resistant cord, driven into mortise, fastens blanket



DETERGENT WASH—Removes solids, grease and fungi causing blinding



ACID WASH—Muriatic acid treatment removes the iron oxide clogging

pressure gauge measuring to 0.01 inch, and an orifice flow meter. The filter cloth is clamped over the circular opening of the plenum chamber by means of a ring. Air flow and pressure measurement are recorded for a sufficient number of settings to permit plotting a curve of the results. The pressure vs. air flow curves for various filter cloth materials may then be compared, and correlated with operating data.

Specific Cloth Qualities Needed

There are several specific qualities in a filter cloth which fit it to serve well under the severe conditions to which it is subjected. Among the desirable qualities are:

1. Good pliability, toughness, snag and abrasion resistance, with a minimum tendency to stretch. These qualities are necessary for satisfactory installation, and for efficient service.

2. Long nap. A nap of ½-inch or more helps to seal the blanket surface, to pick up the proper amount of sludge and to stand the wear caused by contact with the scraper blade.

3. Suitable pressure loss.

4. Resistance to chemicals used in conditioning the sludge and in acid washing the blankets.

During the fifteen years of filter operation, eleven different blanket materials have been used and studied. These are: Cotton, Untreated Wool, Treated Wool, Vinyon, Nylon, 90% Nylon-10% Saran, 25% Nylon-75% Wool, Dynel, 50% Dynel-50% Wool, Orlon, and Dacron.

The weight of blanket materials has varied from 12 to 16 ounces per square yard. Some were napped and others not. The various cloths, except cotton, are rated in Table 1 with respect to factors considered of importance in blanket use under conditions applying at The West-Southwest Sewage Treatment Plant.

Summary of Operating Experience

Cotton

The few cotton filter blankets used during the early years of our plant operation were too expensive, considering their short life and frequent wash requirements. None have been used since panel mounting of filter blankets was adopted.

Wool, Untreated

Untreated wool twill blankets have been our general service filter cloth throughout most of the entire period of operation. All have been long napped, and installed with the nap lying opposite the direction of the drum travel. All were satisfactorily pliable, and all continued to stretch through service. With increasing weight (up to the 14-15 ounce type) the characteristics of the blankets improved. The 12-ounce blankets gave poor initial filter cake pickup. They required pre-service treatment, and frequent washings during service before desired filter cake delivery was obtained. The 16-ounce type blankets were too heavy, as they proved difficult to install and produced a low cake yield. They required too much care to be worthy of extensive study.

The pressure loss measured for the wool cloths (in inches of water) were: 12 ounce, 0.31 to 0.38; 13 ounce, 0.50 to 0.70; and 14 to 15 ounce, 0.45 to 0.80. Pressure loss data on the 16-ounce cloth are not available. The useful life of the 12, 13, and 14 to 15-ounce cloths averaged 1900, 2400, and 2700 hours respectively; However, a few blankets in each class did much better than the average.

Wool, Treated

During warm weather fungus growths clog the interstices of the cloths and tend to fill the backing grooves and drainage channels. In addition, filter blankets out of service for extended periods of time deteriorate as a result of microbial action. To combat this condition, washes of chlorine water, bromine water, pentachlorphenol solution and copper sulfate were used, but with very little improvement. The use of bromine water was very hazardous to the operating personnel.

It was found possible to have the blankets treated at the mill, using a permanent type of bactericide, either before or after weaving. While some blocking of the cloth interstices was occasionally in evidence, the overall results with fabric as treated were satisfactory, and the blanket life was noticeably increased. Pressure loss for these blankets ranged from 0.40 to 0.60 inches, and their service life averaged 3300 hours. Elongation was present throughout service, but was measurably lower than that of the untreated wool cloths. Purchase contact specifications for these treated cloths, used during the past several years, are as follows:

"The weave to be two up and two down, straight twill, with a thread count of approximately thirty-one (31) end warp and twenty-five (25) end woof.

"The material to be all wool, weighing not less than 14½ ounces per square yard, exclusive of wool fat and bactericide; and woven in one continuous piece without seams and one side long napped. The amount of nap to be approved on sample submitted before fabrication. The wool to contain no noils, card fly, card strippings, card waste or reused wool. Garnetted wool not to exceed 25%.

"The warp and woof thread to be twisted 105 turns per foot, and the cloth to be finished in a manner to produce a minimum of stretch in the width. At approximately every 36 to 48 inches as measured along the warp, a woof thread of a dark, distinctive, permanent dyed color will be inserted, to aid the mechanics while installing the cloth.

"The cloth to have sufficient permanent bactericide treatment to protect it throughout its useful filter life. The treatment should add approximately 2½% to the weight of the untreated cloth."

Vinyon

The Vinyon cloths used were not satisfactory, partly because of the type of weave, which presented installation problems and stretching during service; but of more serious consequences, because its poor resistance to acid washing. These cloths were removed after an average of about 1,000 hours of filter blanket service.

Nylon

Highly variable results were obtained with nylon cloths; some had nap, others had to be napped with wire brushes. One or two blankets gave several thousand hours of satisfactory service and stood washing with 17½% muriatic acid. Others deteriorated or glazed when washed with 5% to 7½% muriatic acid, and most of them responded only fairly well to detergent wash. The glazing action appeared to be a partial solution of the fiber with re-precipitation, resulting in a badly clogged cloth having a glazed surface.

The material is durable and abrasion-resistant, with very little dry stretch, but many blankets showed excessive stretch while in service. However, testing is being continued on blankets in the 0.80 to 1.20-inch pressure loss range. It is because of the wide range of results obtained from this material that we have been unable to establish any set program for wash and acid treating, with any degree of assurance that the blanket will be servicable after treatment.

Nylon 90%—Saran 10%

In appearance this combination of cloth resembled the 100% Nylon, but because of the Saran content it became brittle in use, requiring almost daily repairing. It was stiff and bulky, difficult to install. Its reaction to acid washing was similar to that of the 100% Nylon cloths. The pressure loss was 0.74 inches.

Nylon 25%—Wool 75%

This combination of materials is similar to wool in appearance, handling and service, but because of the nylon content it had poor resistance to acid washing. It showed excessive elongation. The pressure loss was 0.62 inches.

Dynel 50%—Wool 50%

This combination was rather bulky, but pliable; pressure loss was 0.90 inches. It withstood scraper abrasion well and responded to all types of treatment, but it stretched in service as badly as 100% wool cloth. It was a quite satisfactory material.

Orlon 100%

This material was very soft and pliable, in appearance it resembled Nylon. The pressure loss was 1.70 inches. It delivered a desirable filter cake but blinded easily. The poor acid resistance of the cloth, and its poor response to detergent washing limited its useful filter life to about 1,000 hours, and its overall use to about 2,200 hours. This material, like Nylon, deteriorated or glazed when acid washed.

Dynel 100%

The studies have included one Dynel blanket having a pressure loss of 1.75 inches, and three in the range of 0.31 to 0.45 inches. The denser cloth was bulky and stiff, difficult to install. The others were more loosely woven, softer and more pliable, and of satisfactory consistency. However, none gave outstanding performance. There was very little stretch during service, and they were responsive to acid and detergent washings, but were not as resistant to scraper abrasion as was desired.

Dacron 100% (Polyester Fibre)

This material is tough and strong, pliable, abrasion-resistant and dimensionally stable. It is acid-resistant, and seems to be water-repellent and rot-resistant. We have twenty-four 100% Dacron filter cloths in service, and the above qualities are outstandingly noticeable in each case. The pressure loss of the Dacron blankets ranges from 0.50 to 1.61 inches. The material has a satisfactory nap and practically no stretch during service. It responds very well to all types of wash treatment.

At present it appears that these cloths are most satisfactory for our use, and will be adopted as our general service filter cloth. They rate high in all respects, and their toughness and durability is outstanding. One filter blanket is in excellent condition after over 11,000 hours of filter service, another has had over 7,000 hours, and several have had over 4,000 hours. None has been patched or repaired in any way, and all continue to give satisfactory filter cake production. No cloth of this type is showing signs of abrasion wear or deterioration from decay.

It is expected that many of these cloths will duplicate or better the outstanding performance of the original test blanket. The use of Dacron on the ninety-eight filters in service will greatly improve operations and reduce our blanket maintenance costs.

Three Important Considerations

The vacuum filtration of sewage sludge imposes severe conditions on the filter blanket. If the blanket is to serve satisfactorily, the cloth must be properly selected, installed, and maintained. In summary:

Selection. Material selected for a vacuum filter blanket should be:

- Tough, strong and pliable.
- Abrasion resistant and dimensionally stable.
- Of suitable pressure loss.
- Of long nap, at least one-half inch long.
- Acid and chemical resistant.

Proper Installation. For proper installation:

- The blanket should be of material that can easily be installed with proper tension and alignment.
- The material should exhibit a minimum dry stretch during installation, as well as a minimum stretch during its service life.

Care. The blanket material should:

- Respond well to water and detergent wash, acid wash, and chemical treatment, without any noticeable injury to the fabric.
- Throughout the service life of the filter cloth, be kept as clean as possible. A clean and pliable cloth will deliver a better filter cake, from a larger filtering area, and will have a much longer useful life.

Conclusions

In Table 1 the column headed "Economic Rating" is based on the original cost of cloth, the installation, repair and maintenance costs, and on the efficient cloth life. The designations 1, 2, 3, and 4 represent what are believed to be the best selections to meet requirements at the West-Southwest Sewage Treatment Plant of the Sanitary District of Chicago. Different conditions would, of course, call for modifications. Although Dacron cloths of the design specified best meet present requirements, the engineering staff of the Sanitary District of Chicago continues to investigate and experiment, always seeking improvements.

Acknowledgements

Design and research on all phases of sludge filtration and disposal for The Sanitary District of Chicago are under the direction of Wm. A. Dundas, General Superintendent; W. H. Trinkaus, Chief Engineer (on leave); H. P. Ramey, Acting Chief Engineer; Langdon Pearse, Sanitary Engineer; F. W. Mohlman, Director of Laboratories; C. P. McLaughlin, Engineer of Mechanical Design. Philip Furlong is Engineer of Maintenance and Operation. Operation of the West-Southwest Treatment Plant is under the direction of A. H. Goodman. Physical research and testing are under the direction of A. J. Beck, Senior Sanitary Chemist and C. G. Poindexter, Asst. Sanitary Chemist. J. W. Wade, Senior Civil Engineer, is responsible for correlating results of operation with specifications.

W&SW

New AWWA Standards Published for Lining Pipe in Place

Specifications for the cement-mortar lining of large steel or cast-iron water pipelines in place have been prepared and published by the A.W.W.A.

The standards cover pipe 16 in. and more in diameter, and provide for materials, surface preparation, and application and curing of the lining. Machine lining of straight pipe sections and long-radius bends is specified, supplemented by hand placement of lining in bends, fittings, and other areas where machine placement is not feasible.

The 6-page booklet, known as AWWA C602, may be obtained from the Association at 521 Fifth Avenue, New York 17, N. Y., upon advance remittance of 25c.

SEWAGE WORKS PRACTICES

Streams and Sewage Treatment

Series 2—Part 1

by DON E. BLOODGOOD

Mr. Bloodgood is Professor of Sanitary Engineering, Purdue Univ., Lafayette, Ind. In this series, he discusses *Sewage Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

A LARGE percentage of the water used by municipalities in the United States is obtained from surface supplies. It is necessary to control in these surface waters the concentration of constituents that make it impossible to prepare a safe and economical finished water. A considerable amount of organic debris does enter streams, and must undergo decomposition if it is not to accumulate in prohibitive amounts. This discussion will review the factors affecting decomposition, as well as the importance of maintaining streams of high quality.

Natural Purification in Streams

The decomposition that takes place when organic matter is discharged into surface water is sometimes considered to be unnatural. In reality, decomposition is a normal method used by nature to reduce the concentration of solids remaining in water.

If decomposition in streams is a natural procedure, it may well be asked, "Why not let nature carry on in her own way?" This would be the very thing to do if decomposition could take place without harming or offending human beings.

The public health is endangered when discharged organic wastes contain pathogenic bacteria. Organisms that live on or in the warm-blooded animals may be harmful to others of the same group. It is also known that few of the pathogens (disease producers) multiply in streams or lakes. Phelps[1] has reported that there is a rapid decrease in the disease organisms once they are discharged into surface waters. Table 1 shows the decrease in numbers of organisms with time.

The environment in a stream is not ideal for the growth of the disease-causing organisms. The decrease in bacterial numbers with time indicates natural purification of the water. It is not safe or advisable to depend upon natural purification, however, because during the period prior to death of the last pathogen some person may consume the water. If the water has not been made safe by treatment, the health of the user will be endangered.

There is more involved in the natural purification of streams than the death of bacteria. Streams receiving sewage will contain organic solids as well as bacteria. It has been previously pointed out in the preceding series that the decomposition of organic matter in streams may cause a nuisance. This will occur if the available oxygen is not adequate to meet the needs of a growth of bacteria sufficiently large to consume the organic solids. When the concentration of solids in the water is *less* than that amount needed to support a growth of bacteria which will use the oxygen in the water faster than it can be replaced from the atmosphere, then there will be dissolved oxygen remaining in the water.

Reaeration in Streams

According to Phelps[1], Stearns stated in 1890 that stream flows of less than 2.5 c.f.s. per thousand sewered population was insufficient to prevent offensive conditions, and that a stream flow of 7 c.f.s. would practically guarantee a satisfactory dilution.

Seven cubic feet per second is 37.7 million pounds per day (7.0 c.f.s. × 60 sec./min × 1440 min/day × 7.5 gal./c.f. × 8.33 lb./gal. ÷ 1,000,000). The B.O.D. per capita is .167 pounds or 167 pounds for one thousand persons. The solubility of oxygen in fresh water 9.2 ppm. at 68° F. In 37.7 million pounds of water there would be (37.7 × 9.2) 347 pounds of oxygen. If there were no reaeration of the stream (and there always is), 167 pounds of oxygen would be used and (347 — 167) 180 pounds would remain in the water. The dissolved oxygen content would be (180 ÷ 37.7) = 4.8 ppm.

Aeration of the water in the stream takes place quite rapidly, particularly if the oxygen content of the water is considerably below the saturation point. Exposing a water surface to the air permits oxygen to enter the water very readily. It may be useful to think of the oxygen molecules as

TABLE 1
Death Rate of *E. Coli* in the Ohio River

Warm Weather		Cool Weather	
Days	% Dying	Days	% Dying
0	100	0	100
2	90	2	85
4	99	4	95
6	99.5	6	97
8	99.2	8	98

TABLE II
Saturation of Water With Oxygen

Temp. °F.	D.O. ppm	D.O. ppm 2000 ppm chlorides
32	14.6	11.3
41	12.8	10.0
50	11.3	9.0
59	10.2	8.1
68	9.2	7.4
77	8.4	6.7

bullets flying around freely in the air. When they hit a water that is not saturated with oxygen they are not readily returned to the atmosphere. However, when the water becomes saturated, the rate of oxygen returning to the air is equal to the rate of oxygen entering the water.

Oxygen Concentration Variation

Turbulent water such as that flowing over rough stream beds, over dams, and in very shallow streams, readily picks up oxygen. In many instances where oxygen is being consumed by bacteria in oxidizing organic matter, the oxygen is being replaced from the air at a rate that maintains the dissolved oxygen at or near the saturation point.

If the oxygen cannot be supplied to the stream as rapidly as it is being used, the oxygen soon disappears and the body of water is then said to be septic. Once a body of water has become septic the decomposition of organic matter does not stop, but rather a different type of decomposition takes place in which the oxygen is obtained from the organic constituents. Septic action is termed anaerobic decomposition. Anaerobic decomposition is usually taking place in the sludge banks that form in streams which receive organic polluting materials.

The quantity of oxygen that can be held in the water of a stream depends upon the temperature of the water. The salt content of water is also a factor that determines the concentration of dissolved oxygen. Table II shows that the higher the temperature the lower the concentration of oxygen required for saturation, and the higher the salt concentration the lower the saturation point[2].

The Stream Flow Factor

The Stearns figures on the rate of flow of a receiving stream and the quantity of sewage discharged certainly indicate that rate of flow is very important in determining the intensity of pollution. The amount of dissolved oxygen present in water is an indication of the severity of the pollution. Table III gives data collected on White River below Indianapolis some years ago[3]. It shows that the dissolved oxygen was as high as 11.8 ppm when the flow in the stream was 1471 c.f.s., and that it was as low as 0.3 ppm when the flow was 324 c.f.s. Table III shows that rate of flow has an effect on the dissolved oxygen. There are other factors, such as temperature and B.O.D. load, that must also be taken into account if an exact mathematical relationship between stream flow and dissolved oxygen is to be established.

TABLE III
Stream Flow and Dissolved Oxygen
White River, Below Indianapolis, Ind.

Month 1933	Temp. °C.	D.O. ppm	Thousands of Lb. BOD/Day	Flow in River c.f.s.
January	7	10.5	36.0	3337
February	1	11.8	35.4	1471
March	7	9.1	31.6	4494
April	12	8.8	41.3	3559
May	18	7.2	53.3	7494
June	26	2.8	55.1	1036
July	26	0.2	40.8	436
August	26	0.5	46.2	436
September	25	0.7	46.4	641
October	17	2.3	31.4	454
November	13	0.3	42.8	324
December	9	1.0	36.4	415

Temperature Factor in Streams

An elevated temperature, in addition to decreasing the amount of oxygen in water, also increases the activity of microorganisms that are decomposing organic matter. The result is that oxygen is used more rapidly in the summer than in the winter. Table IV illustrates the relative rate of decomposition at several temperatures[4]. The figures in the table show that the rate of decomposition at 62° F. is twice as fast as it is at 35° F.

Stream Quality and Plant Operation

The preceeding discussion shows the effect of temperature and stream flow on the apparent condition of the stream. Perhaps comment on the importance of temperature and stream flow to sewage plant operation is in order.

Babbitt[5] reports that the removal of B.O.D. in primary sedimentation treatment plants to be 37 per cent.

In considering primary treatment only (and there are many plants that provide only primary treatment) it is reasonable to believe that this degree of treatment usually does remove enough B.O.D. in the summer when the stream temperature is 70° F. or more. From Table IV it can be seen that the activity in the stream would be much less at a lower temperature. In fact, if primary sedimentation removed 37 per cent of the B.O.D. during the warmer period, the stream might be expected to have about the same dissolved oxygen content as if primary units were by-passed during the time the stream was at a temperature of about 55°. It is true that the solids settled out in the stream might form sludge banks. The importance of considering the temperature factor before deciding when to make repairs to a sewage plant can readily be seen.

Streams and Public Health

Sewage-contaminated water can be so treated that the resulting product is suitable for human consumption. In purifying a contaminated supply, however, there always is the likelihood that some day some pollution may get through the water treatment plant without adequate purification. The chances of producing a safe product, therefore, are much better if the raw water supply contains relatively few pathogenic bacteria.

The bacteria are removed from sewage in various treatment processes. Some bacteria are attached to solids and are removed when the solids settle out. Single bacterial cells are probably coagulated into clumps in the activated sludge and trickling filter processes. Chemical coagulation, no doubt, helps in the removal of some bacteria. Care must be taken to see that the bacteria are destroyed after removal from the sewage with sludge solids. Most disease organisms die in the foreign environment of the sewage plant (the digestion tanks, etc.), however, it is not possible to be sure that all dangerous organisms are destroyed unless the sludge solids are heated to a temperature sufficient to kill bacteria.

Streams and Fish Life

The number of pounds of fish that can be grown per year in a given volume of water depends upon the food supply available, and how satisfactory the environment is. It has been pointed out that the decomposition of organic matter in streams is accomplished largely by microorgan-

TABLE IV

Temperature and Rate of Decomposition of Organic Matter in Streams

°F.	Relative Rate of Decomposition	°F.	Relative Rate of Decomposition
35	1.000	60	1.892
40	1.137	62	2.000
45	1.292	65	2.155
50	1.468	70	2.450
55	1.666	75	2.790

TABLE V

Variation in Dissolved Oxygen Over 24-Hour Period Clearwater Lake, Waconia, Minn.

Time Hour	Dissolved Oxygen, ppm	Time Hour	Dissolved Oxygen, ppm	Time Hour	Dissolved Oxygen, ppm
10 A.M.	3.1	6 P.M.	10.5	2 A.M.	6.5
11	3.9	7	10.3	3	5.3
12 Noon	4.5	8	11.6	4	4.6
1 P.M.	5.2	9	11.1	5	3.7
2	6.6	10	9.8	6	2.1
3	5.1	11	9.2	7	3.0
4	5.1	12 Mid.	11.3	8	2.7
5	9.3	1 A.M.	7.6	9	1.6

isms. The mocroorganisms become food for the larger forms of life and eventually fish use either plants or crustacea for food.

If decomposition has altered the environment by lowering the dissolved oxygen to a point where there is not enough remaining to support fish life, then the fish will die. However, if the decrease in oxygen is not enough to harm the fish, then the fish should appear in greater numbers or size because of the increase in food that is available from organic matter.

Katz and Gaufin[6] have reported that they found pollution may be detrimental to fish even when the dissolved oxygen concentration is adequate. They believe that the pollution is not directly responsible for fewer numbers of fish in water with ample oxygen, and they are of the opinion that pollution so changes the flora in the stream that there may not be suitable food in certain parts of the stream for the fish.

Southgate[7] has reported that rainbow trout are killed in a short period at an oxygen concentration of 2.0 ppm at temperatures between 15 to 17° C. Trout are the most sensitive of all fish to oxygen deficiencies. Extensive studies have been carried on in recent years by the National Council for Stream Improvement (of the Pulp, Paper and Paperboard Industries) on the effect of oxygen concentration on various fish. The Aquatic Life Advisory Committee of the Ohio River Valley Water Sanitation Commission has said that well-rounded warm water fish populations require at least 3 ppm of oxygen at all times, and that for sixteen hours per day the water should contain not less than 5 ppm.

Algae Growth in Streams

Algae, like other plants, grow best when fertilized. A stream that receives nitrogenous materials soon turns them into plant food. Thus, the natural purification that takes place in a stream provides food for algae. Algae are plants which give off oxygen in the sunlight and use some oxygen in the dark. The exact effect of algae on the stream condition is not easily predicted, because of fluctuations in numbers of algal cells and the hours of sunlight that can be expected.

The algae can, in bright sunshine, produce and give off enough oxygen to super-saturate the water. A very good idea of the variation in dissolved oxygen in water that may be expected in a day at one particular point is given by the data presented in Table V.

The data given in Table V illustrate two things: (1) algae can add large amounts of oxygen to a stream, and (2) it makes a great difference at what time of day a sample is taken to determine the dissolved oxygen[8]. Certainly these data show that the seriousness of the pollution in this lake could not be determined by taking a sample in the afternoon. The indications are that algae usually will produce more oxygen in the daytime, by the process known as photosynthesis, than they will use up in the darker hours by respiration.

Sludge Banks in Streams

Sludge banks are formed in streams when the settleable solids in the water are deposited at locations where the velocity of the water is low enough to permit deposition. Sewage or industrial wastes not treated by primary sedimentation are sure to produce sludge banks unless the stream is flowing with a high velocity. Dissolved and colloidal solids also may form sludge banks in streams if these materials are transferred into settleable solids by microorganisms. Therefore, treatment in addition to primary sedimentation may be necessary in order to prevent the formation of sludge banks.

Requirements for Pollution Control

If pollution control is to be enforced for the preservation of stream quality, then the regulations should indicate the condition of the stream that must be maintained rather than the quality of water that can be discharged into the stream. It seems essential also that all pollution control laws should in some way limit the discharge of settleable solids, bacteria, dissolved organic matter and those substances that are considered to be toxic.

CORRECTION

To the Author's Eleventh Installment discussing "Gas from Sewage Sludge."

We have been requested to correct a statement in Professor Bloodgood's "Sewage Works Practices" Eleventh Installment, page 512, November 1954 issue of **Water & Sewage Works.**

In the second column, in the paragraph beginning "Methane weighs . . . . .", it is stated that: "On the basis of 68 per cent methane and 32 per cent carbon dioxide, one thousand cubic feet of gas would weigh 97.5 pounds". Several readers have pointed out that the weight value stated is too high.

Professor Bloodgood has recalculated this value and requests that a correction should be made so that the sentence will read: "On the basis of 68 per cent methane and 32 per cent carbon dioxide, one thousand cubic feet of gas would weigh 69.5 pounds".

References

1. Phelps, E. B., *Stream Sanitation*, p. 217. John Wiley and Sons.

2. Theroux, Eldridge and Mallman, *Analysis of Water and Sewage*, p. 216. McGraw-Hill Book Company, 1943.

3. Annual Report, Indianapolis Sewage Treatment Plant, 1933.

4. Calculated from the basic information given by Phelps in *Stream Sanitation*, p. 72. John Wiley and Sons.

5. Babbitt, H. E., *Sewerage and Sewage Treatment*, p. 363. John Wiley and Sons. Sixth Edition.

6. Katz, M. and Gaufin, A. R. "The Effects of Sewage Pollution On the Fish Population of a Midwestern Stream," *Transactions of the American Fisheries Society*, Vol. 82, pg. 156-165. (1952)

7. Southgate, B. A., "Oxygen and Rainbow Trout," *Salmon and Trout Magazine*, March 1933.

8. Purdy, W. C., "Reoxygenation of Polluted Waters by Microscopic Algae," *Public Health Reports*, Vol. 52, No. 29, pg. 945-978, July 16, 1937.

9. Wabash River Pollution Abatement Needs, Ohio River Valley Water Sanitation Commission, pg. 25.

W&SW

Standard Methods 10th Edition Is Now Available

The long-awaited 10th Edition of *Standard Methods for the Examination of Water, Sewage, and Industrial Wastes* has been published as a joint enterprise by the APHA, the AWWA, and the FSIWA.

This important edition of *Standard Methods* is more than 200 pages larger than the ninth edition. It's text is completely new, providing for the first time new methods, discussions of the significance of results, and details of principles such as the precision and accuracy of results. Included are drawings of 300 aquatic organisms of biological significance.

The six divisions of this Edition are: Physical and chemical examination of Water; Sewage; Industrial wastes; and Sludges; Bacteriological examinations of water for sanitary quality; and Biological examinations.

List price of *Standard Methods* is $7.50. Price to members of any of the three associations who send cash with order is $6.50. Send orders either to APHA, AWWA, or FSIWA headquarters.

Des Moines Water Board Adopts $4.5 Million Program

The Des Moines Water Works board of trustees voted in January to adopt "in entirety" a long-range plan presented by consulting engineers for a $4,594,000 expansion of the water works plant.

The board also authorized the engineering firm—Alvord, Burdick & Howson of Chicago, Ill.—to proceed at once with plans and specifications for the first step in the program.

Dale L. Maffitt, water works general manager, called approval of the long-range plan "the biggest decision the board has made in a long, long time."

It was generally agreed by board members that they would "make every effort" to pay for the expansion out of water works profits, without issuing bonds.

McCallum New Head Of USPHS Water Pollution Control

Surgeon General Mark D. Hollis (left) and Director Gordon E. McCallum (right)

Gordon E. McCallum, Sanitary Engineering Director of the U. S. Pubic Health Service, Department of Health, Education, and Welfare, has been appointed to head the Service's Water Pollution Control Program, Surgeon General Leonard A. Scheele has announced. Mr. McCallum, who has been chief of the Office of Health Emergency Planning since July 1951, will be succeeded in that post by Dr. John B. Hozier, Medical Consultant.

Mr. McCallum has been a career sanitary engineering officer of the Public Health Service for the past 20 years. During World War II, he was detailed to the U. S. Office of Civilian Defense where he served as Chief Engineer. Previously, he had filled engineering assignments in Public Health Service field offices in Atlanta, San Francisco and New Orleans.

As Chief of the Office of Health Emergency Planning for the past four years, Mr. McCallum has served as the Surgeon General's principal staff advisor in planning and coordinating emergency programs and activities of the Service. These activities are carried on in close cooperation with the Defense Planning Office of the Department of Health, Education, and Welfare, with the health counterparts of other Federal agencies such as the Federal Civil Defense Administration, the Office of Defense Mobilization, the Department of Defense and the Atomic Energy Commission, together with professional groups and such organizations as the National Research Council and the American National Red Cross.

In his new post, Mr. McCallum will head one of the most important sanitary engineering activities of the Service. The current water pollution control program gained its real impetus under the Water Pollution Control Act of 1948 and the Amendments of 1952. This program supports State projects for protecting the purity of the Nation's water supply and works with States, interstate agencies, cities and industries. Research is conducted in water pollution problems, and findings are put into field practice. Consulting services are made available to the States on the technical aspects of water pollution control. The program also is charged with responsibility for carrying out activities of the Public Health Service in connection with interstate pollution problems.

Over-Under Relief Sewer Design Simplifies Construction

by WILLIAM A. MARCON

Mr. Marcon is project engineer, Department of Public Works, Westchester County, White Plains, N. Y. In this paper he describes how construction of a 24-in. corrugated metal pipe relief sewer, above an existing 15-in. line, was selected as the most convenient and economical solution to a problem.

WHEN the Sheldrake West Branch Sewer, a part of Westchester County's intercepting sewer system, was built twenty-five years ago, it was considered expedient to temporarily utilize a considerable length of existing fifteen-inch vitrified clay sewer. It was the intention of the County to replace this section when the sewage flow from the twenty-four-inch pipe discharging into it approximated the capacity of the fifteen-inch. Population growth in the sewer district has reached a point where the smaller sewer is no longer adequate to handle increased flow. During wet weather and other periods of high flows, surcharging of sewers and flooding of basements have occurred.

The fifteen-inch sewer is located in the Town of Mamaroneck, N. Y., and extends from Rockland Avenue, approximately 2100 feet to Valley Stream Road, where it connects with the Sheldrake East Branch Sewer. Most of the sewer is laid in rock and is located in residential streets.

Various solutions were investigated to relieve the situation, and the following three methods appeared to be feasible:

1. The construction of a relief sewer at a higher grade than the existing fifteen-inch, but paralleling it about five feet away.

2. The replacement of the existing fifteen-inch sewer with a new and larger sewer, in the same trench and at the same grade as the fifteen-inch.

3. The construction of a new relief sewer in the same trench, directly above and parallel to the existing fifteen-inch, leaving the existing line in operation.

Because of the large amount of rock along the line, method 1, that of paralleling the existing sewer with a new line was rejected as too expensive. Extensive blasing would have been necessary and would have caused material damage to the existing fifteen-inch sewer and to the water, gas, and storm drain lines which underlie the narrow streets. Laying a new sewer by this method would have necessitated several relocations of utilities, and new house connections.

Method 2, that of replacing the pipe, appeared satisfactory except for the tedious and involved operation, during construction, of pumping sewage in a highly developed residential area, replacing all house connections, and widening the existing trench.

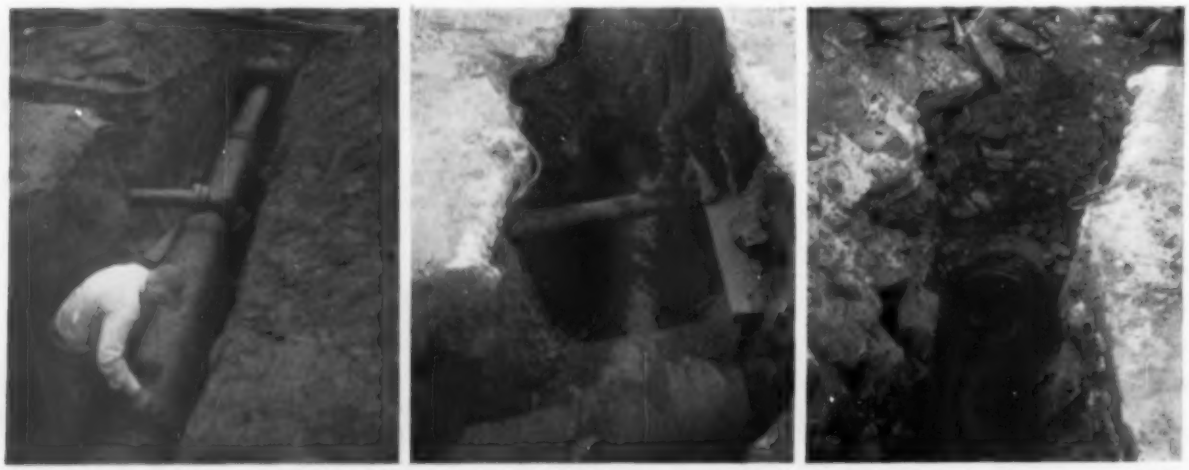
Method Economical and Convenient

Method 3, that of constructing a new relief sewer above the existing fifteen-inch pipe, although heretofore untried by the Department of Public Works, was agreed upon in view of its economy and the minimum inconvenience that it afforded the residents of the area concerned. A study was made of the possible construction methods and materials required.

A comparison of estimated costs for the three methods revealed that method 3 would be twenty and ten thousand dollars less expensive respectively than methods 1 and 2.

Twenty-four-inch diameter, coated and lined corrugated metal pipe was selected for the relief sewer because of its light weight, long lengths and ease of installation.

As shown in Fig. 1, approximately one-foot clearance was allowed between the existing fifteen-inch pipe and the corrugated metal relief pipe. The distance was set to allow for clear-



SHELDRAKE PROJECT—(Left) Corrugated pipe in place, showing connecting band with silo lugs; (Center) Pipe entering manhole through steel sleeve; (Right) Backfill placed over completed relief sewer line.

ance of existing house connections and also to prevent breakage of the underlying fifteen-inch line by excavating equipment. Machine excavation was permitted to within one foot above invert grade and hand excavation was required for the remainder.

Approximately 175 feet of the existing sewer is laid in the bed of the Sheldrake River. It was decided to replace the existing sixteen-inch cast iron pipe under the stream, in this section, with twenty-four-inch C. I., mechanical joint pipe in the same trench. Because this section was only three feet below the stream bed, cast iron pipe was selected to prevent flotation and reduce the possibility of damage from stream clearing equipment.

In general, the work progressed according to plan. The corrugated pipe was furnished in twenty-foot lengths with one foot, silo lug, connecting bands. Pipe laying was rapid due to the fact that no rock had to be blasted, and the excavation consisted of former backfill material. Also, the flexibility of the corrugated pipe allowed deflections to be made at certain joints to miss obstacles in the path of the pipe. The time-consuming task of making joints was greatly reduced by using twenty-foot lengths of pipe and silo lug connecting bands.

Connections at manholes were given special study. To avoid cracking the mortar at the connection, a somewhat flexible joint was required. This was accomplished by inserting a twenty-eight-inch diameter steel sleeve fifteen inches long and ⅜-in. thick into the manhole and mortaring it in place (see Fig. 2). The corrugated pipe was later inserted into the steel sleeve and caulked with a hot bituminous jointing compound. This type of joint allowed for slight settlement of the pipe without damage to the manhole or pipe.

Specifications called for a heavy bituminous coating on all corrugated metal and the repair of this coating wherever it was damaged by handling.

Our problem was to alleviate surcharging of the Sheldrake Sewer and the resulting flooding of cellars in the area. With the new design, when sewage rises in the manholes to one foot above the top of the existing fifteen-inch pipe, it will begin to flow to the next manhole through the twenty-four-inch relief pipe. Each section between manholes has a different slope, thereby producing different depths of flow. With the relief pipe in place, no manhole will surcharge above the flow line in the twenty-four-inch pipe, the elevation of which is below the danger point. Formerly sewage rose to the top of certain manholes and, in some cases, spilled out onto the surrounding ground.

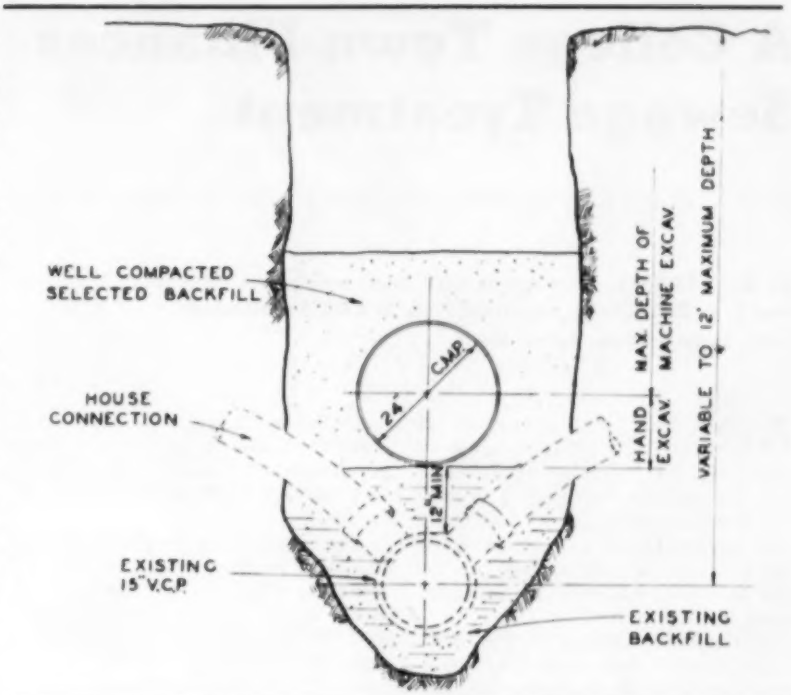


Fig. 1—TYPICAL DETAIL through trench carrying corrugated pipe relief sewer

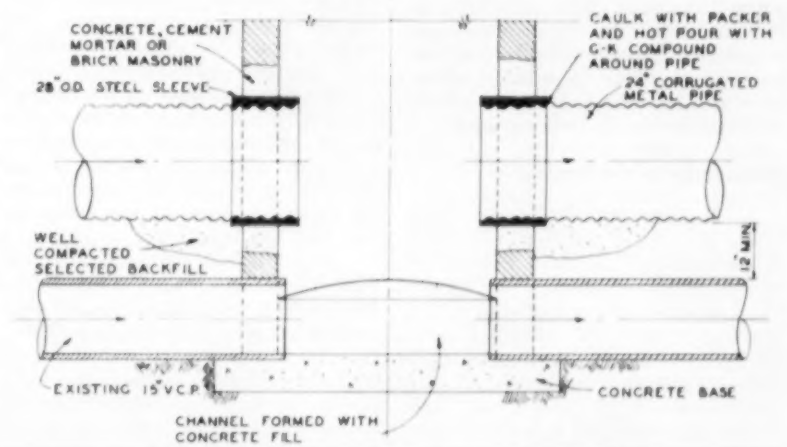

CONCRETE, CEMENT MORTAR OR BRICK MASONRY
28" O.D. STEEL SLEEVE
CAULK WITH PACKER AND HOT POUR WITH G-K COMPOUND AROUND PIPE
24" CORRUGATED METAL PIPE
WELL COMPACTED SELECTED BACKFILL
12" MIN
EXISTING 15" V.C.P.
CONCRETE BASE
CHANNEL FORMED WITH CONCRETE FILL

Fig. 2—SPECIAL FEATURES of manhole connections for corrugated pipe sewer line

This method, we believe, can substantially reduce the costs of relief sewer construction where existing sewers are laid in rock and where their capacities are inadequate. It is only suitable, however, where grades are relatively steep and where depths below basements are ample.

Frank Bracalello, Inc., of Scarsdale, N. Y., was the Contractor. The total bid was $58,991.57, which averaged about $28.00 per lineal foot. The final studies and design for this project were carried out by the author under the immediate direction of L. G. Rice, Consultant on design and construction, and under the general supervision of G. E. Griffin, Deputy Commissioner of Public Works in charge of the Sewer Devision and Mr. James C. Harding, Commissioner of Public Works for Westchester County, New York.

W&SW

A College Town Finances Sewage Treatment

How both the City of Ames and Iowa State College profit by cooperation

by M. T. SKODJE, Associate in Civil Engineering,
and E. R. BAUMANN, Associate Prof. in Civil Engineering,
Iowa State College, Ames, Iowa

A CHAPTER was completed on February 17, 1954, in a story depicting the friendly relationship and cooperation between a college town and its college. The last entry was in the form of a check for $94,-551.20, paid by the college to the city as a final settlement of an agreement written in 1947.

The opening chapter of this story began farther back than 1947, however; in 1941 to be exact. At that time Iowa State College, located at Ames, Iowa, found itself faced with the necessity of reconstructing and enlarging its sewage treatment plant. The College's original intent was to finance the plant from its "Repairs, Replacements, and Alterations" appropriation from the State Legislature. World War II brought about labor and material shortages, and the construction had to be postponed.

Investigation of the Problem

At the same time, the City of Ames was confronted with an identical problem, that of a badly overloaded sewage treatment plant. The two decided to investigate the possibility of cooperating in a joint venture. A committee was formed for that purpose with representatives from the City Council and from the College. The committee employed a firm of consulting engineers. The engineering firm presented a preliminary report which indicated that the cost of constructing and operating a single plant, capable of serving both parties, was more economical than the cost of constructing and operating two separate plants. Surveys and flow measurements made in 1943 indicated that the flow from the College was about 30 per cent of the total flow to be expected at the single plant.

At the end of World War II, the situation was made more acute by a large increase in College enrollment and a corresponding increase in the City's population. The College's sewage treatment plant, which was built in 1920, was designed to serve about 2,500 students. In 1941 the College enrollment was 6,300; by 1947 it had reached 9,200 and was still increasing.

The City's treatment plant also was designed in the early twenties. In 1920 the population of the City of Ames totaled 6,270. The population in 1940 was 12,555, and by 1948 it was estimated to be 16,000.

Joint Plant Cost Estimates

In 1947 the Iowa Legislature was asked to authorize the Board of Education to enter into an agreement with the City of Ames to construct a joint sewage treatment plant and outfall sewer. On March 12, 1947, City Manager J. H. Ames submitted to the College Committee on Sewage Disposal Plant, an estimate of the cost of constructing and operating the joint plant along with a proposal for establishing a sewer charge to cover the College's share of the construction and operating cost.

The plant was estimated to cost $484,114 and the outfall sewer $150,-000, making the total estimated construction cost approximately $635,-000. It was proposed that the College's share of the construction cost be 30 per cent, or about $190,000, based upon the 1943 flow measurements. The College had earmarked from the "Repairs, Replacements and Alterations" appropriation, $100,000, which would leave a balance of about $90,000 to be amortized. The annual operating cost was estimated to be $27,800 and 30 per cent of this was $8,340. The annual cost of amortizing the construction balance in 20 years at 3 per cent was $6,135, and totaling this with the operating expense results in an annual assessment on the College of $14,475.

The City's proposal was that this estimate be accepted and a charge be made to the College of 5.9 cents per hundred cubic feet of sewage contributed. This charge was computed by dividing the $14,475 annual college cost by the average daily flow of sewage from the College; the flow being that determined in 1943 of 500,000 gallons (2,449,100 cubic feet) per year.

The College's computation of a satisfactory charge differed from the City's, primarily in the per cent to be charged in amortizing the construction balance. College authorities suggested further discussion, and concluded that the establishment of a fixed rate was impractical because of the lack of knowledge of construction and operation costs at that time.

It was agreed that the Board of Education, if legislative consent could be obtained, would join with the City in the construction and operation of the sewage treatment plant, and that the plant should be paid for on the basis of the actual proportion of sewage flow which each party would contribute. The measurements for such a determination were to be made over a period of one year after metering facilities were in place.

Construction Contract is Signed

During the plant construction stage, it was agreed to share the costs on the basis of the 1943 flow measurements. It was decided by the College to pay all the obligations as incurred on the basis stated above, by allocating an additional $100,000 from the "Repairs, Replacements and Alterations" appropriation. This was done to reduce the annual costs by the amount required to amortize the balance on the construction cost.

As the two parties were in substantial agreement as to the procedure for responsibility and payment, the matter was then referred to the City Attorney to draw up an agreement to be executed by the Board of Education and the City Council. The Board then requested and received from the Legislature a joint resolution authorizing the use of $200,000 from the "Repairs, Re-

placement and Alterations" appropriation for the construction of the joint plant.

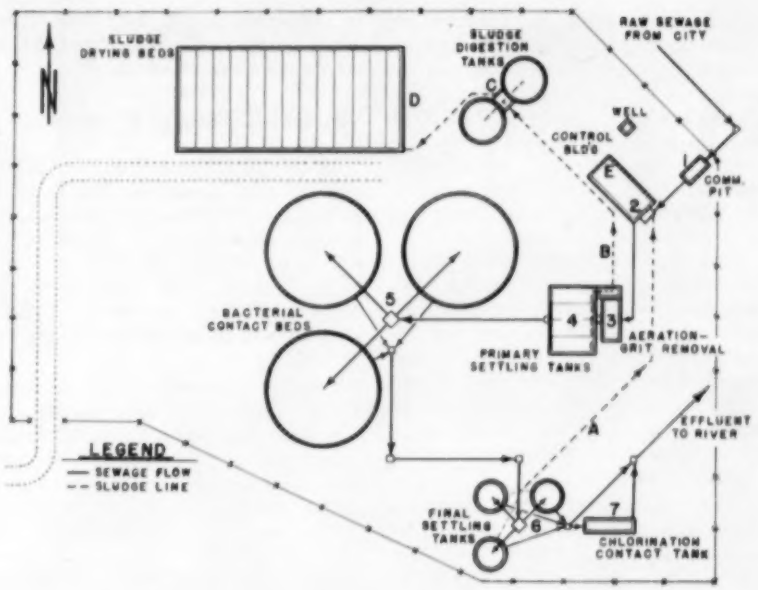
Following this authorization, the College and the City concluded a contract on June 3, 1947. The contract provided for the construction of a sewage treatment plant to be designed, constructed, and operated by the City. The costs which would not, according to the contract terms, be charged to the College were the costs of billing the College and the interest on the bonds sold by the City to finance its share. Both the College and the City would share proportionately the cost of plant operation, but any plant improvement during the year which would require an expenditure of more than $500 would have to be approved by the Board of Education.

Before the construction of the plant, the City was to build an outfall sewer from the College to the Skunk River, above the new plant location, and allow the College to divert immediately, the overload flow from its treatment plant into the City's sewer. The City was to bypass sewage into the river when necessary, with the stipulation that should any legal difficulties arise from this practice the City could cease to accept the College's sewage, pending completion of the new treatment plant.

Costs Rise: More Money Needed

In July, 1948, the City accepted bids on the project. The lowest bid received was about $960,000, which, when added to engineering costs and miscellaneous items not included in the contractor's bid, made the total cost of the project approximately $1,000,000. Previous to taking bids on the treatment plant, the City had awarded contracts for the outfall sewer. The College's share of the outfall contract was about $47,500, leaving approximately $152,500 from the $200,000 originally available. Since the total cost of the College's share of the plant construction cost would have been approximately $300,000, the College had insufficient funds available for fulfilling the terms of the contract.

The problem was presented to the Interim Committee of the Iowa Legislature, and a request was made for funds to meet the College's share of the cost. The Interim Committee was unable to allocate the funds, since the Attorney General ruled that the Joint Resolution had set a limit of $200,000 which could not be exceeded without legislative authority.



DIAGRAM—Joint sewage treatment plant serving Ames, Iowa, and Iowa State College

The City, therefore, rejected the bids as there appeared to be no means for financing the College's share of the plant.

The project was readvertised and bids were again received on January 18, 1949. The total cost rose to $1,094,970, of which the College's portion would be about $328,500. This now left a shortage of $176,000. In view of the urgent need for the treatment plant, the legislature, upon reconvening, appropriated the additional $176,000.

New Plant in Operation

The plant was completed and began operation on November, 1950. Both old treatment plants were abandoned and all sewage flow was directed to the new plant. By February, 1951, flow measurements were undertaken. At the treatment plant, the total sewage flow was measured in a Parshall flume equipped with a continuous recorder. The College sewage flow was metered at the outlet of the College collection system by a commercial flow-measuring nozzle connected to a recording meter at the treatment plant. The City's sewage flow was computed as the difference between the two meter readings.

The first twelve months of metered operation was completed in February, 1952. In accordance with the 1947 agreement, discussions were inaugurated to bring about a final settlement of the treatment plant's construction costs and first year's operational costs. According to the flow measurements, the College contributed 45.4 per cent of the total flow and the City 54.6 per cent. This record indicated that the College would be required to pay the City the difference between the 45.4 per cent of the cost and the $376,000 already paid.

The total cost for the plant was $1,202,000 and, after deducting the expenditures not shared by the College, the net jointly-shared liability was $1,182,535.86. Even though both state-financed appropriations had already been contributed, the College still owed approximately $160,000 on the basis of these recorded flows.

The fact that the sewage flow from the College had apparently increased by a greater percentage than the total flow had increased, caused the City and College officials to agree to continue metering before making the final settlement; this procedure would rule out any temporary variations in the flow measurements. Since the College's proportion of the flow was greater than the estimated 30 per cent, in order not to delay payment to the City, the Board requested that the legislature appropriate a sum sufficient to make the payment when the actual sewage volumes were determined. This final appropriation amounted to $190,000.

Metering Devices Under Investigation

A check of the metered water consumption both by the City and by the College indicated that the City showed the larger increase in the

period from 1943 to 1952. Both parties agreed that an investigation should be made to determine the accuracy of the metering devices. The Parshall flume was checked in 1951 and in 1953 and found to be accurate. These checks were made volumetrically, using the primary clarifier of the sewage treatment plant as a calibrating pit.

The City then requested a certificate of accuracy for the sewage flow-measuring nozzle from the manufacturer. An engineer checked the installation for the manufacturer and found it to be recording 0.8 per cent high, according to their calibration curve. The engineer made some minor repairs and adjustments to the recording meter.

Flow tests were made upstream from the nozzle using a current meter. These tests, made by disinterested engineers, indicated that the flow from the College might be greater than determined in 1943, but that it was not 45 per cent of the total flow. The College then constructed a 12-inch, rectangular wier in a manhole located 87 feet upstream from the nozzle. The results of a week of flow measurements again indicated that the nozzle reading was high. The weir installation appeared to substantiate the fact that there was an error in the percentage of flow attributed to the College.

Volumetric Calibration of Nozzle

With this information, the College and the City agreed in March, 1953, to build a calibrating pit to check the nozzle volumetrically. Construction of the pit, which was 10-ft. x 25-ft. x 16-ft. deep, was financed in the same manner as the treatment plant. The low bid on the calibrating pit was $6,450.

During September and October, 1953, a calibration curve for the nozzle was determined volumetrically, using the pit installation. The results indicated that the manufacturers calibration curve was 125,000 gallons above the in-place calibration. The College's share of the total flow, and thus of the construction cost, was recalculated to be 39.62 per cent. The manufacturer then installed and calibrated a new nozzle and sent the old nozzle to their hydraulic laboratory for tests. These tests showed the nozzle to be correct and indicated that the error had been made in the installation.

The total cost of the construction shared jointly, including the calibrating pit, came to $1,187,660.78, of which the College's share based upon the new percentage of sewage flow contributed was $470,551.20. Since the College had already advanced a sum of $376,000, the final payment to the City was $94,551.20.

Fairness the Predominating Element

Throughout the thirteen years, including the last two years of investigation, one element predominated all negotiations. That was a sincere concern on the part of the public officials involved to solve a sewage treatment problem and to finance it in fairness to both parties.

Acknowledgement is due Lynden Faris, Construction Engineer for Iowa State College, and H. F. Seidel, Superintendent of Water and Sewage Treating for the City of Ames, for the engineering data contributed; and to H. F. Seidel and B. H. Platt, Business Manager for Iowa State College, for making available all correspondence pertaining to this project and for their helpful suggestions and comments during the preparation of this paper.

W&SW

Bayonne Chamber of Commerce Reports With Pride On Contributed to New Sewage Treatment Plant

We published in our May 1953 issue an article headlined "Bayonne Chamber of Commerce Sets Unusual Example of Public Service." The organization was commended for undertaking to act as "Watchdog," and investing $30,000 to hire engineers as advisers on progress of the city's $10 million sewage treatment plant.

Now, through the cooperation of Harvey D. Leuin, Exec. Vice President of the Bayonne Chamber of Commerce, we are able to complete the story by summarizing the organization's final report on the project. We again commend the organization, and suggest that copies of the entire report, signed by H. M. Greffin, President, will be of value to many other municipalities.

"The Board of Directors of the Bayonne Chamber of Commerce, because of the inevitably high cost of a sewage disposal plant, saw the necessity of doing everything it could to keep the cost down as low as possible for the good of everyone in Bayonne.

"The Chamber, as a first consideration, took all necessary steps to keep itself constantly well informed in regard to the Sewage Disposal Plant Project. It recognized the fact that final authority on all questions having to do with the construction of a disposal plant rested entirely in the hands of the Board of Commissioners of the City, and that its contribution to the construction of a good disposal plant at reasonable cost must be an advisory one.

"The first Chamber sewerage committee was appointed in December 1948. For the past eighteen months a well-known engineering firm has been retained as the Chamber's representative on the construction of the project, but without supervising authority, giving particular attention to unit price items while determining whether the construction work was being done in accordance with standard construction practice and in accordance with the plans and specifications as approved by the City. For this service the Chamber has expended to date $22,448.00, subscribed by many firms and individuals in Bayonne, all Chamber members, who were interested in seeing that the best possible sewage disposal system was obtained.

"In this six year period the Chamber's volunteer Sewerage Committees have devoted thousands of man-hours in consultation, study and investigation, attended all hearings before the Interstate Sanitation Commission, State Board of Health, Superior Court of New Jersey, and in holding meetings with the several Boards of Commissioners and engineers representing the City, to accomplish this purpose.

"The total cost of the completed project is less than the $10,000,000 limit set by the City Officials, although until recently when a number of adjustments and changes were made which resulted in material reductions of costs to the City, it appeared improbable that this goal could be achieved.

"The constructive action taken by the Chamber of Commerce through the study and recommendations of its committees over a six year period, together with the field work, inspection and reports of its Engineers, contributed materially to the satisfactory construction of the largest municipal project ever undertaken in Bayonne. The resulting savings to the taxpayers of the City represents a sum many times the cost of the services of the Chamber's Engineers."

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W&SW

Meetings Scheduled

May 3-5—Pittsburgh, Pa. *(Hotel Webster Hall)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

May 9-11—Lafayette, Ind. *(Purdue University)*
TENTH PURDUE INDUSTRIAL WASTE CONFERENCE. Director, Professor Don E. Bloodgood, Purdue University, W. Lafayette, Ind.

May 10—Newark, N. J. *(Hotel Essex)*
NEW JERSEY SECTION AMER. INST. OF CHEMICAL ENGRS. (Symposium featuring control of stream pollution). John N. Whelan, E. I. DuPont de Nemours & Co., Parlin, N. J.

May 19—Springfield, Mass. *(Hotel Kimball)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

May 19-21—Yakima, Wash. *(Chinook Hotel)*
PACIFIC NORTHWEST SECTION A.W.W.A. Sec'y, F. D. Jones, Room 305, City Hall, Spokane, Wash.

May 25—Trenton, N. J. *(Tentative)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

May 26-27—Ocean City, Md. *(Commander Hotel)*
MARYLAND-DELAWARE WATER & SEWAGE ASSOCIATION. Sec'y W. M. Bingley, 2411 N. Charles St., Baltimore 18, Md.

June 8—Bar Harbor, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

June 12-17—Chicago, Ill.
AMERICAN WATER WORKS ASSOCIATION. (75th Annual Convention). Exec.-Sec'y, Harry E. Jordan, 521 Fifth Avenue, New York 17, N. Y. (All reservations being cleared through A.W.W.A. office.)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, R. C. Sweeney, 21 No. Broadway, White Plains, N. Y.
(joint meeting with)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R. I.

June 16—York Harbor, Maine, *(Marshall House)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

June 17—Berkeley, Calif. *(Univ. of Calif.)*
NORTHERN CALIFORNIA SECTION of the AMERICAN INSTITUTE OF CHEMICAL ENGINEERS (For Further Information Contact E. G. Foster, Shell Development Co., Emeryville 8, Calif.).

June 22-24—Rochester, Minn. *(Kohler Hotel)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Geo. F. Bernauer, 713 Chapman St., Madison, Wis.

June 22-24—Columbus, O. *(Deshler-Hilton Hotel)*
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE. Sec'y. Ward E. Conrad, 301 Ohio Departments Building, Columbus, O.

Aug. 15—Richmond, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. Rupert Kountz, Penn. State University, State College, Pa.
(joint meeting with)

(Continued on Page 106A)

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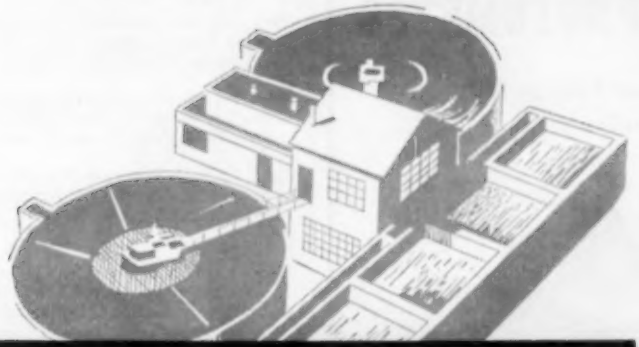

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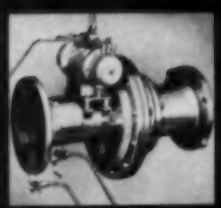

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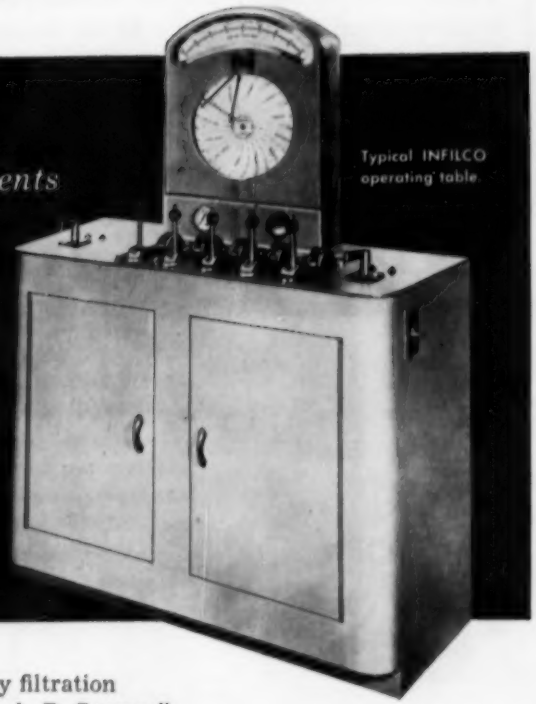

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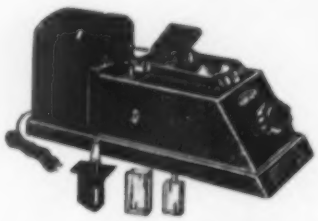

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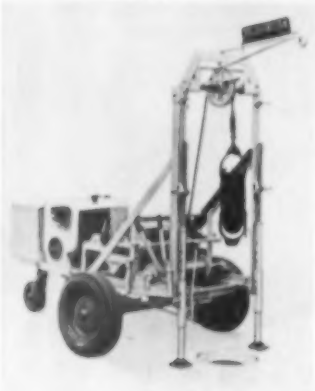

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(Continued from page 104A)

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. B. Bush, State Dept. of Health, Kirby Health Center, Wilkes Barre, Pa.

Sept. 7-9—Saranac, N. Y. *(Saranac Inn)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 7-9—Fort Dodge, Ia. *(Hotel Waukonsa)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, S. Leary Jones, 420 Sixth Ave., Nashville, Tenn.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 553 S. Limestone St., Lexington, Ky.

Sept. 14-16—Flint, Mich. *(Durant Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, State Dept. of Health, Lansing, Mich.

Sept. 18-22—Lake Placid, N. Y. *(Lake Placid Club)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Sept. 19-21—Laramie, Wyo., *(Connor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, J. W. Davis, Johns-Manville Sales, Inc., Denver, Colo.

Sept. 21-23—Columbus, O. *(Neil House)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, O.

Sept. 21-23—Milwaukee, Wis. *(Hotel Schroeder)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison, Wis.

Sept. 21-23—Winnipeg, Manitoba, Canada *(Royal Alexandra Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 25-27—Joplin, Mo., *(Connor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, W. A. Kramer, Rm. 3, 6th Floor State Office Bldg., Jefferson City, Mo.

Oct. 4-5—Springfield, Ill. *(Place not selected)*
ILLINOIS WATER PLANT OPERATORS CONFERENCE, ANNUAL MEETING. Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.,

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Annual Meeting). Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

(joint meeting with)

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Oct. 11-14—Atlantic City, N. J., *(Chalfont Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION (Annual Meeting) Sec'y, Davis Dunlap, 2609 N. Second St., Harrisburg, Pa.

Oct. 12—Norridgewock, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 16-19—San Antonio, Tex. *(Gunter Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 19-20—Clarksburg, W. Vir. *(Waldo Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION (9th Annual Meeting) Sec'y, G. O. Fortney, State Dept. of Health, Charleston 5, W. Vir.

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Equipment — Products
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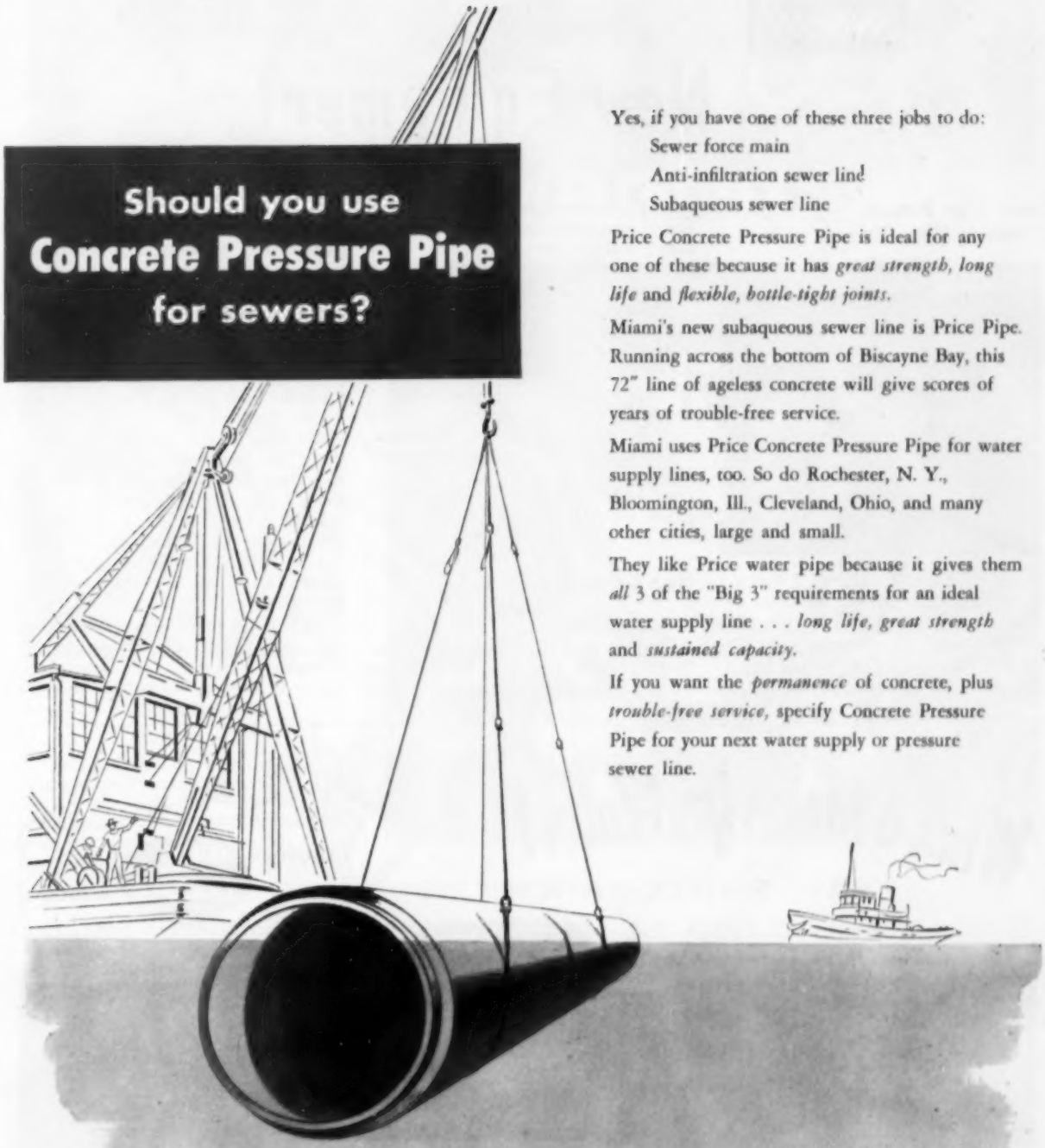
Should you use Concrete Pressure Pipe for sewers?



Yes, if you have one of these three jobs to do:

Sewer force main
Anti-infiltration sewer line
Subaqueous sewer line

Price Concrete Pressure Pipe is ideal for any one of these because it has *great strength, long life* and *flexible, bottle-tight joints.*

Miami's new subaqueous sewer line is Price Pipe. Running across the bottom of Biscayne Bay, this 72" line of ageless concrete will give scores of years of trouble-free service.

Miami uses Price Concrete Pressure Pipe for water supply lines, too. So do Rochester, N. Y., Bloomington, Ill., Cleveland, Ohio, and many other cities, large and small.

They like Price water pipe because it gives them *all* 3 of the "Big 3" requirements for an ideal water supply line . . . *long life, great strength* and *sustained capacity.*

If you want the *permanence* of concrete, plus *trouble-free service,* specify Concrete Pressure Pipe for your next water supply or pressure sewer line.

Price Brothers Company

1845 East Monument Ave.
Dayton 1, Ohio

Member American Concrete Pressure Pipe Association

Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

W&SW

New Equipment

New Type Precast Concrete Filter Bottom

501

"M - C - G" (McGivern & Assoc.) Company, Columbus, Ohio has developed a new precast concrete filter bottom called "Criscrete."

The drainability and equal distribution of the Criscrete system is patterned after the time tested cast-iron lateral grid system of 3/8 inch diameter holes, 4 holes per square foot. It is constructed of concrete and employs non ferrous nozzle liners, insuring immunity to corrosion, electrolysis and tuberculation.

The unit requires 6 inch overall depth in the filter and employs a 16 foot module in one dimension and is obtainable in any length up to 26 feet in the other dimension. False bottoms or supports are not required as the unit is precast prestressed concrete built monolithically to span the entire width of the filter in one piece.

High Capacity Chlorinator

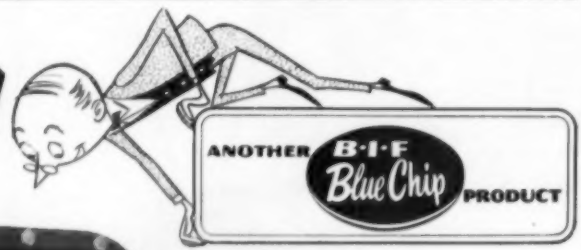
502

Fischer & Porter Company, Hatboro, Penna., has developed an improved high-capacity solution feed type chlorinator with a corrosion-proof polymer-impregnated fibre glass cabinet that never requires painting. Use of the diaphragm regulator principle permits a safe, reliable, mechanically-enclosed chlorinating machine constructed entirely of corrosion-resistant materials.

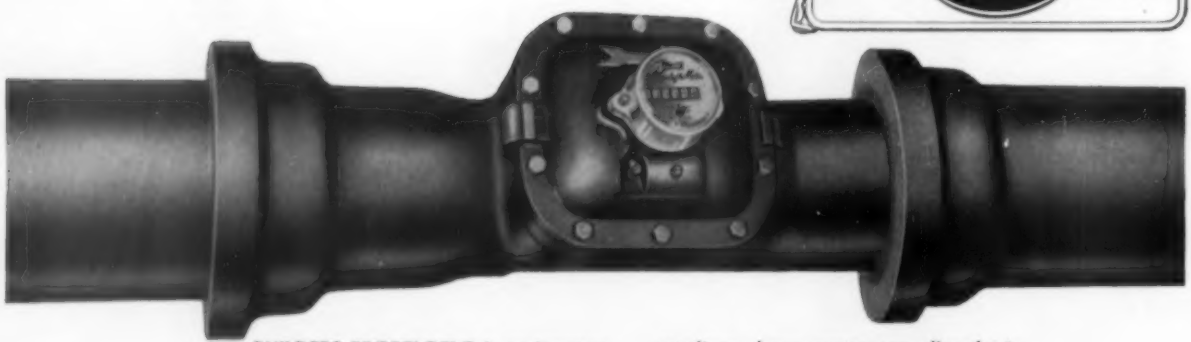
Manual adjustment of chlorine gas injection is made by the rate valve on the front of the cabinet, and the actual flow rate is observed through the glass flow meter. Six metering tube and float combinations, interchangeable from the front of the cabinet, provide 10 to 1 or greater overlapping flow ranges from a minimum of 100 pounds per day to a maximum of 8,000 pounds per day of chlorine gas.

In addition to manual chlorine flow rate adjustment, the chlorinator is available with the following automatic functions: Automatic propor-

What a Meter for Water!



ANOTHER B·I·F Blue Chip PRODUCT



BUILDERS PROPELOFLO is an inexpensive main line meter for totalizing water consumption. Gives dependable, trouble-free service on the job. Meters accurately over wide range — six-digit totalizer shows water use directly in gallons, cubic feet, etc. For complete information on this easy-to-install meter, write to Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

BUILDERS-PROVIDENCE

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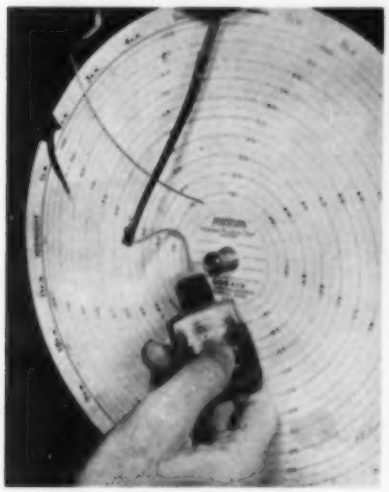
BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

B·I·F METERS FEEDERS CONTROLS

tioning by a transmitted pneumatic signal from an orifice, venturi, or variable-area flow meter; Automatic proportioning by mechanical connection to a float in a flume, weir or tank; Remote pneumatic set; Program controlled operation; single, or multiple cam-operated; Timer sequence control; Automatic pump sequence control; and Automatic start-stop control.



New Recorder Ink Comes in Squeeze Bottle Dispensers

503

The Foxboro Co., Foxboro, Mass., has developed a new general purpose ink for use with their recording instruments. It was especially formulated for use with Foxboro pens and Humitex charts to produce the sharpest possible record of a process variable.

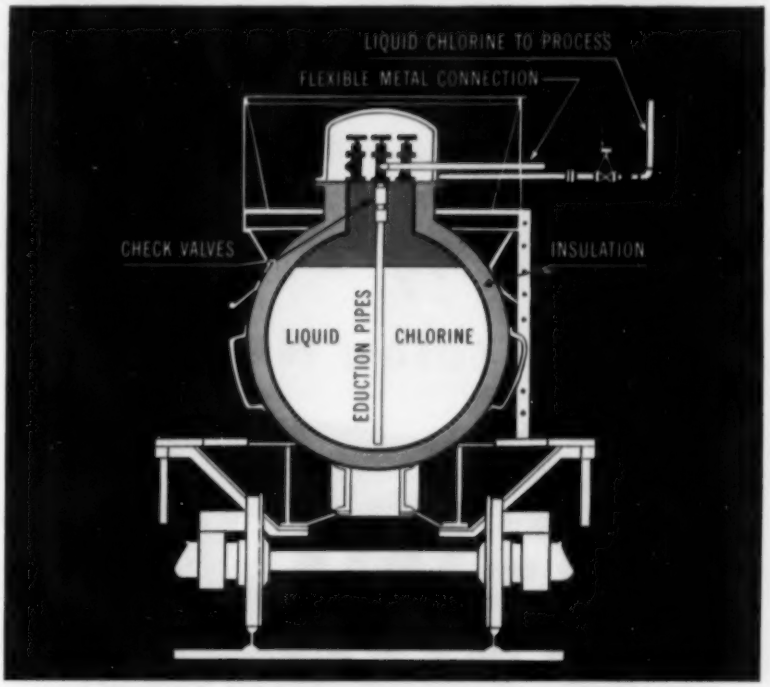
Containing no sediment, the new ink is smooth flowing, will not clog the pen, and dries quickly without feathering the chart. Special properties give it a wide range of performance under varying industrial conditions. It is rated for high temperature, and can also be used down to 0°F.

For convenience in inking the pen, Type 1500 ink is furnished in a newly-designed one-ounce polyethylene squeeze bottle. An exclusive plastic capillary tube and filter assembly enables the user to pinpoint a precise quantity of ink on the pen without dripping it on chart or instrument. Box pens can be tube-filled through the point and need no additional priming prior to use. The bottle is quickly sealed for leakproof storage by inserting the tip of the filling tube into a receptacle in the closure.

The new ink in the unbreakable plastic dispenser is furnished in red, violet, blue, green and black.

Chemicals you live by

Diamond Chlorine



HERE'S ANOTHER WAY WE LOOK AT CHLORINE...

This drawing from the DIAMOND ALKALI Chlorine Handbook—illustrates another way we look at chlorine: as a product that should be handled with maximum safety and efficiency.

As one of America's largest producers, shipping from four strategically located plants, we have accumulated a wealth of chlorine knowledge—money-saving information and safety know-how FREELY available to you. For prompt shipment or service, call your nearby DIAMOND Sales Office or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

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CHLORINE PLANTS: Edgewood, Md.—Muscle Shoals, Ala.—Painesville, Ohio—Houston, Texas.

SALES OFFICES: New York, Boston, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, and Houston.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

One-Coat Vinyl Coating For Corrosion Protection

504

Amercoat Corporation, South Gate, Calif., has announced the development of a new vinyl mastic protective coating that need be applied in only one coat.

The new coating can be applied at a thickness of 10 mils in one double-pass spray coat. According to the company the vinyl mastic produces its heavy film thickness without sacrificing the chemical and moisture resistance for which vinyls are so well known.

Despite its unusually high solids content, the coating is applied with conventional industrial spray equipment. The dense, highly impermeable protective film does not flow away from edges and sharp corners and therefore provides extra protection for these areas which are particularly susceptible to corrosive attack.

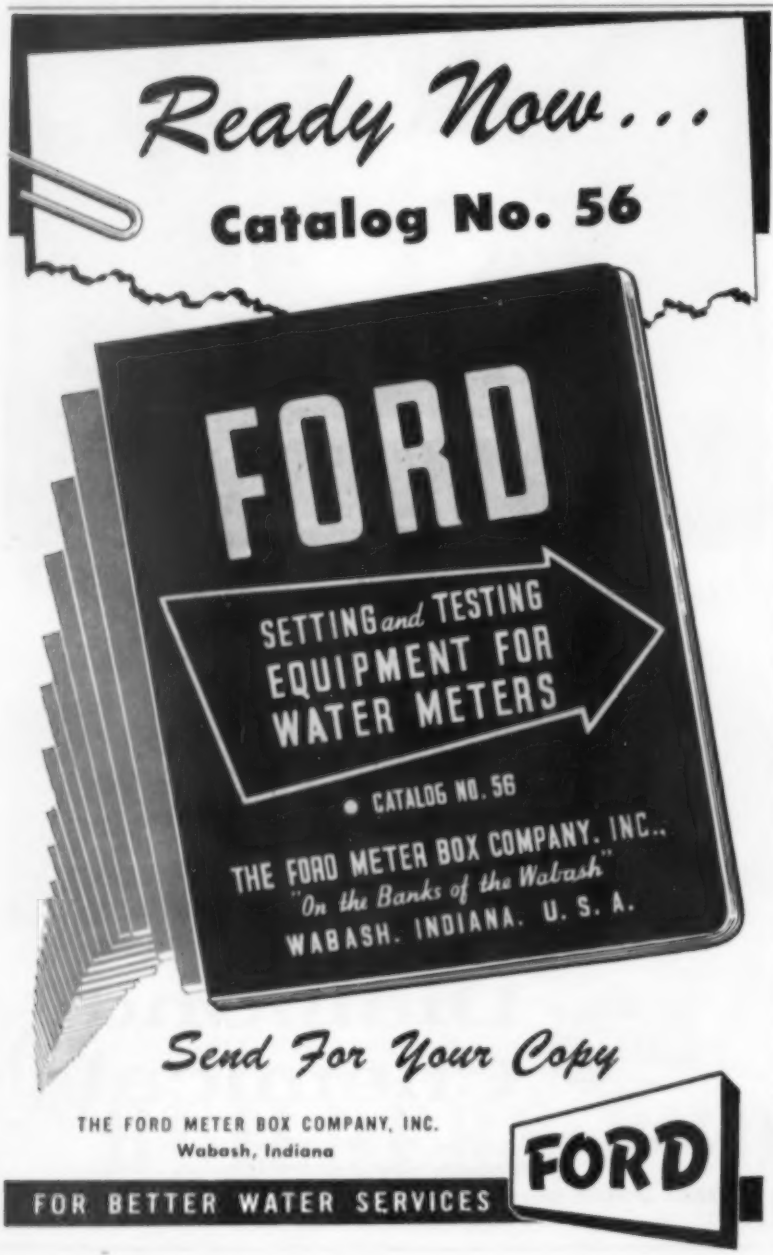
Submersible Sewage Ejector

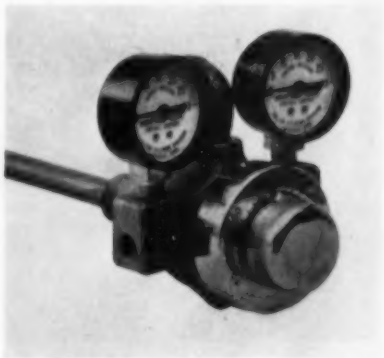
505

The Weil Pump Co., Chicago, Illinois, has developed a new submersible sewage ejector with 5 and 6 inch discharges, at capacities up to 2000 GPM. The ejectors are designed to operate underwater and to economically handle both heavy duty sewage and extreme drainage problems.

The new 5 inch pump is a heavy duty screenless type, equipped with a non-clog impeller. The motor is mounted directly on top of the pump casing. The motor is water cooled.

The unit is designed for continuous operation during flood periods. The operating parts are not subject to corrosion, deterioration, or injury when standing idle—regardless of weather conditions. The unit is self-contained with sealed bearings. The lubricant used requires change only once in every five years.





Thermostatic Pilot Controller

506

Fulton Sylphon Division, Robertshaw-Fulton Controls Company, Knoxville, Tenn., has developed a new thermostatic pilot controller, unusually small in size rugged in construction.

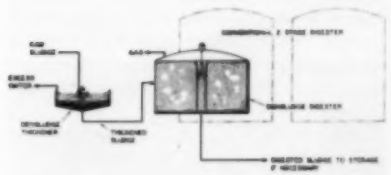
The new pilot controller, measuring only 3-13/16" in width, provides accurate temperature control of liquids or air when used in conjunction with valves, dampers, and other controls. It is readily employed in control systems of sewage disposal systems and other applications in which rapid response and adjustable control characteristics are required.

The new instrument, called the "Fultrol" pilot, is installed at the location where temperature is to be maintained. The extremely sensitive rod-and-tube thermal element of the instrument is immersed directly in the medium being controlled. Because of its unusual construction, the new controller may be installed in any position . . . vertically, horizontally, or diagonally.

Any change in temperature at the thermal element activates a small pilot valve, which in turn varies the control pressure applied to a motor valve or any other final control device. The FulTrol pilot, the Company said, is modulating in action.

Digester Requirements Decreased By Densludge Digestion

507



Dorr-Oliver Incorporated, Stamford, Conn., has announced the development of Dorrco Densludge Digestion for the digestion of sewage sludge. When it is employed in combination with the Dorrco Densludge Process of sludge thickening, digester capacity requirements are decreased 67 to 78% depending upon the type and degree of treatment. Capacity reductions are due to physical means which increase efficiency by mixing during digestion and by thickening before digestion rather than in the secondary tanks of conventional systems.

In the light of recent tests conventional two-stage digesters appear to be rather inefficient in that full capacity is not utilized for sludge detention. These tests have demonstrated that without mixing as little as 35% volume utilization is achieved in primary digesters while the entire capacity of secondary units is used to effect solids-liquid separation. When the Densludge Process of sludge thickening is employed in conjunction with Densludge Digestion, raw sludge is concentrated in a Thickener before being digested, excess water is removed before rather than during digestion, and supernatant and the need for secondary digestion is thus eliminated. With but half the volume of sludge to be digested only half the capacity is needed in the primary digester. Another savings in volume is realized by using a draft tube mixer to increase volume utilization from 35 to 65%. Thus, in Densludge Digestion, Thickeners and digesters with draft tube mixers depend one upon the other.

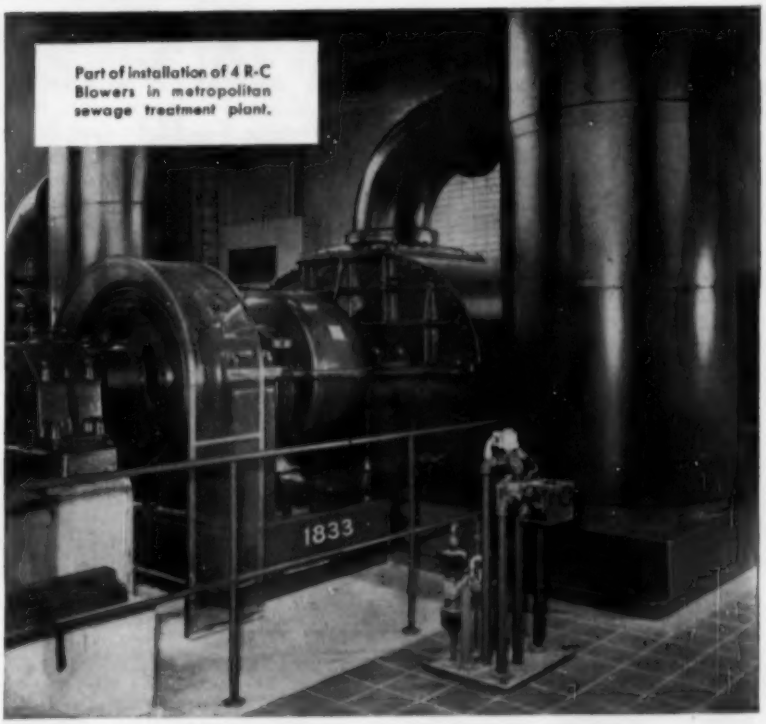
New "Hexteel" Floor Armor Safe, Durable and Light Weight

508

Klemp Metal Grating Corp., Chicago, Ill., has announced a new "Hexteel" safety floor armor, that has less weight per square foot and a greater exposed steel surface.

The new Klemp ⅜ in. x 16 gage (.065) Hexteel has been developed

(Continued on page 112A)



No failures in volume or pressure with R-C Rotary Blowers

CHECK THE "BIG 4" ESSENTIALS

1. Accurate volume at required pressure
2. High efficiency—low operating cost
3. Low maintenance cost —low down time
4. Freedom from oil or oil vapor contamination

Check your present blowers and if they don't measure up, it may be an economy to replace them with modern R-C equipment.

In any capacity, from 5 cfm to 50,000 cfm, R-C Rotary Positive Blowers faithfully and accurately deliver their rated volumes and pressures. That's one most important reason for their wide use in sewage treatment plants where positive control of these two basic characteristics is essential.

But there are other reasons, too, for the selection of R-C Blowers wherever air must be moved for industrial processing. Check the accompanying list of "BIG 4" essentials and you'll see why sturdy R-C Rotary Positive Blowers have long been "standard" with thousands of purchasers for widely varying applications.

If you have a job of moving air or gas, call the R-C engineer. With Rotary Positives, Centrifugals and the new Spiraxials, he can give you unbiased counsel and suggestions. Or, write us about your needs, and we'll send informative bulletins on equipment for new installations or replacements.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
155 Mount Ave. • Connersville, Indiana

to meet the increasing demand for a new type steel floor armor which can be used for resurfacing existing concrete or wood floors. The exposed steel surface armor is 18.15 square inches per square foot, and the weight of the new Hexteel is 1.7 lbs. per square foot.

Hexteel surface armor, filled with a mastic, is ideal for resurfacing ramps, garages, etc., or wherever rough usage decreases the lasting durability of the surface area or flooring.

One feature of the new Hexteel is that it can be used as a steel armor in new concrete floor installation, as well as in conjunction with a mastic fill on existing concrete or wood floors. Installation is simple because the sides and ends are easily locked together on the job to form a continuous steel armored floor, and it is easily anchored to the existing floor by means of a Ramset or other similar type of fastening device.

"Temporary" Repair Provides Permanent Solution

509

Punch-Lok Company, Chicago, Ill., has reported the following case history:

In rehabilitating a sewage treatment plant, it was discovered that water had frozen and split a 24-inch diameter cast-iron elbow. It would have taken weeks to obtain a replacement —and the removal and replacement of the elbow would have been a major operation, critically delaying the program.

Several attempts to repair the elbow failed. Finally they tried clamping it with Punch-Lok open-end, heavy duty clamps which were applied with a small Punch-Lok locking tool. The clamps successfully pulled the split elbow together to the extent that leakage was negligible. The repair was at first considered to be of a temporary nature, but now, after five years of service, the elbow is still tight.

This is one of the many case histories described and illustrated in Clampways Ideas, a pocket-sized booklet published by the company.

MH

The World's Best Valve is THE "PAY-OFF"!

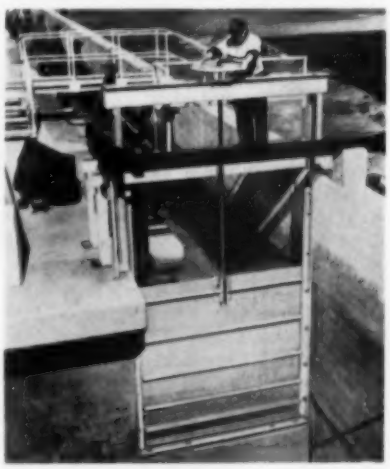
Research . . . engineering . . . mechanical tests . . . laboratory tests . . . discussions . . . arguments . . . flow tests . . . operating tests . . . field tests . . . . . ideas, theories, plans . . . more research . . . more drawings . . . more tests . . . on and on and on over the years!

That's the long road down which has come today's specifications for M&H Valves & Hydrants.

The "pay-off" is the world's best Valve and Hydrant.

No wonder that M&H business volume grew and grew, that the plant needed to be expanded time after time, that inevitable leadership in the industry should come to the M&H organization and its products. No wonder that field service under practical operating conditions should prove the exclusive advantages of M&H Valves and Hydrants. For details write M&H VALVE & FITTINGS COMPANY, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION



Aluminum Slide Gate

510

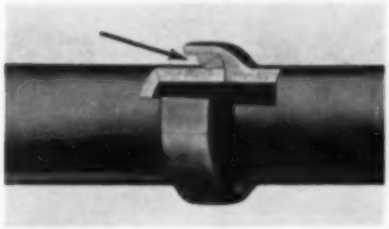
Rodney Hunt Machine Co., Orange, Mass., has developed a low cost, easily installed aluminum slide gate.

The gate, made of sheet aluminum reinforced with extruded aluminum angles, can be used where economy as well as function can be served, for example, as a stop-gate in by-pass channels. Not only is the gate low in cost in comparison with other types, but also, only a simple frame is required for installation.

The gate is controlled by a manually operated bench-stand hoist with control stem. In normal flow, it is corrosion resistant. The manufacturer recommends use of the aluminum slide gate when odd channel sizes are present in design, full channel flow is desirable, and where closure can be made under balanced conditions.

Mechanical Joint For Vitrified Clay Pipe

511



The Clay Sewer Pipe Association, Columbus, Ohio, has announced the development of Wedge-Lock clay pipe, that is said to be root-proof, infiltration-proof and has a self-sealing, double-ball mechanical joint.

Wedge-Lock, on which patents are pending, is designed for installation in high-water table areas and wherever root-proof joints are desired. The new pipe is available in 4-, 6-, and 8-in. diameters, both standard and extra-strength. A complete line of matched fittings and a special union for jointing cut ends are also provided.

The new pipe has a wide, solid ring of plastisol around the spigot end of the pipe's barrel. A conical ring of the same plastisol is cast inside the bell. Following a light application of water, clay and water mixture, oil, or adhesive, the spigot is inserted into the bell of the adjoining length. The length is then "shoved home" by hand or with a metal bar, forming the joint in seconds. The ball plastisol casting in the bell aligns the pipe and holds it securely.

Curb Box Charger

512

Basil Miller, Elkhorn, Wisconsin, has available the Miller Curb Box Charger.

The charger is a device that contains a powerful Alnico magnet that will impart a magnetic charge to any piece of iron that is within range of its magnetic effect. It is made long and slender so that it projects its magnetic charge deep into the earth and when it comes within range of a curb box the lines of magnetic force link up with those of the curb box and greatly intensify the magnetism of the curb box.

In using the Miller Curb Box Charger on new work, the handle is shoved down, and the charger is tapped on the top of the curb box, the handle is then pulled all the way back up and the job is done. The company states that once a box is charged, the charge lasts indefinitely and re-magnetizing is not necessary.

SPECIAL ATTACHMENTS for Water-Sewer Jobs Multiply Hydrocrane's Value

Special attachments, designed specifically for water and sewer jobs, make the all-hydraulic Bucyrus-Erie crane-hoe an even greater favorite among utilities. They not only speed specialized digging and cleaning jobs, but are equipped with quick change fittings — permit switching attachments in a few minutes.

Your Bucyrus-Erie distributor will demonstrate the all-hydraulic Hydrohoe or Hydrocrane — show you how custom-matched attachments can save time and money. Complete literature is yours for the asking. Write today.

Catch Basin Bucket

Closes hydraulically, opens by spring pressure. This unit has achieved outstanding results cleaning sewer catch basins. Bucket is 1½-cu. ft. capacity and only 15-in. in diameter when closed. This permits working through small manhole openings.

Hydrohoe Special "Utilities" Dipper

Tailor-made for water and sewer work users, this new 22-in. wide, wrist-action dipper is especially designed for digging holes of greater depth than length. Dipper rotates 95° from 45° behind handle to 50° ahead. Here is an invaluable attachment for digging manholes, valve and hydrant pits, uncovering pipe leaks.

New ⅜-yd. Clamshell Bucket

Long, sharp teeth quickly knife into tough clay and hardpan. Smooth clean bowls shed sticky dirt in a hurry. Bucket cleaner optional. Bucket closes by two hydraulically operated rams. Use of twin rams instead of single center ram provides 42 per cent more force to lips at point of closing.

66H55

Plus . . . Three-tine grapple, 1-yd. trash bucket, ½-yd. materials bucket, 12-, 18-, and 24-in. hoe dippers, crane hook, cab.

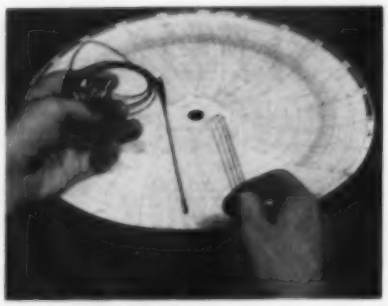
BUCYRUS-ERIE COMPANY South Milwaukee Wisconsin

New Instrument Recording Pen Saves Operating Dollars

513

The Bailey Meter Company, Cleveland, Ohio, has developed a new instrument recording pen that is said to save operating dollars daily by speeding data interpretation and relieving skilled personnel of monotonous duties.

This featherweight, stainless steel capillary pen is fed from a clear, hermetically-sealed, plastic ink sac containing over a year's supply. Capillary action maintains continuous flow to a precision ground point



which traces a sharp, opaque, quick-drying record. "Poisoning" of intersecting records is practically eliminated, thus perfecting chart legibility. As many as four pens trace on parallel time arcs only forty-two thousandths of an inch apart, which simplifies record interpretation and analysis.

The sealed inking system prevents sludge and oxide formation. It is contamination proof, non-corrosive, non-evaporating, and delivers an uninterrupted flow of fresh ink in brilliant color. Pens have run on equivalent 15-year accelerated tests at ambient temperatures from 20F to 140F without breakdown or appreciable wear.

The one-year, automatic inking will save many man-hours per day in plants where hundreds of tank-type recording pens require day-to-day refilling by operators or skilled technicians.

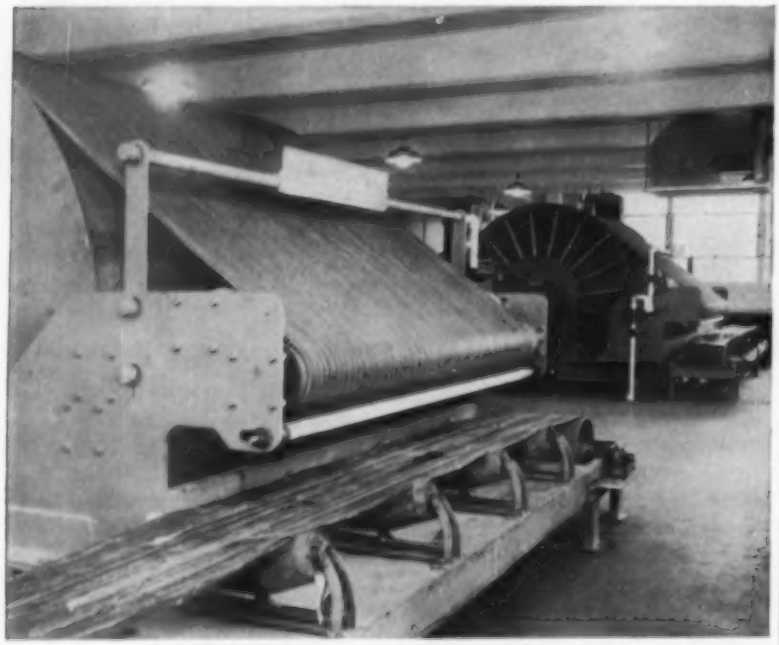
Four Wheel Drive Truck Mounted Ditcher

514

Barber-Greene Company, Aurora, Ill., has announced a new four wheel drive-truck mounted ditcher, Model 711.

To provide for extreme mobility over the road and surefootedness on bad terrain, the Model 711 is mounted on the four wheel drive Dodge "Power Wagon". This vehicle offers a 45 m.p.h. road speed, ample, dependable power, plus additional features such as a fully enclosed operator's cab, lights, regular truck steering, etc.

This new model may be equipped with either of two digging booms. One has a five foot digging depth and the other three feet six inches



Filter equipment in Darby Creek Joint Authority Sewage Treatment Plant, Darby Township, Pa.

In plants of any capacity,

Pennsalt Ferric Chloride simplifies sewage treatment

Whatever the capacity of your plant, Pennsalt Ferric Chloride, *in liquid or anhydrous form*, can increase your vacuum filter efficiency:

- **by superior coagulating and flocculating action;**
- **by increasing filter capacity;**
- **by producing drier, easier-to-handle cakes.**

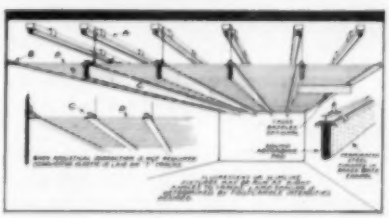
Write for free technical information on Pennsalt anhydrous and aqueous ferric chloride. Industrial Chemicals Department, Pennsylvania Salt Manufacturing Company, 1104 Widener Bldg., Phila. 7, Pa.

OTHER PENNSALT CHEMICALS FOR WATER AND SEWAGE TREATMENT: Alum, chlorine, chlorinated lime, Perchloron® (high-test calcium hypochlorite).

Pennsalt District Offices

Appleton, Wis.—Appleton 3-9307
Atlanta, Ga.—Vernon 0241
Chicago 1, Ill.—Andover 3-6170
Cincinnati 2, Ohio—Main 3168
Cleveland 15, Ohio—Main 1-6205
Detroit 26, Mich.—Woodward 1-8031
Paterson 1, N. J.—Lambert 5-3500
Philadelphia 7, Pa.—LOcust 4-4700
Pittsburgh 19, Pa.—Atlantic 1-5233
St. Louis 1, Mo.—Central 1-2338

Pennsalt Chemicals

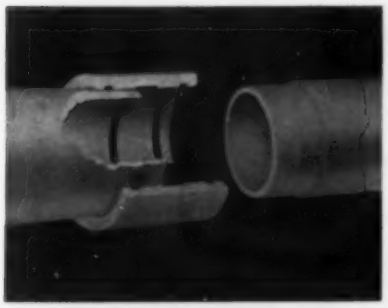


Luminous Ceilings

515

Luminous Ceilings, Inc., Chicago, Illinois, has developed a new type of lighting that consists of a translucent corrugated ceiling of thin Lumi-Plastic suspended to the desired level below evenly spaced rows of slimline fluorescent light sources.

The plastic ceiling diffuses the room illumination of the entire area, giving it uniform distribution and eliminating shadows and glare. Acusti-Louvers are easily attached to the metal track holding the white plastic, to also effectively give noise correction.



Pre-Assembled Ring-Tite Coupling

516

Johns-Manville, New York, N. Y., has developed a new, pre-assembled Ring-Tite Coupling for installation by hand without tools. It is for use with Transite Building Sewer Pipe, the asbestos-cement pipe for connecting homes with street sewers or septic tanks.

Essentially, the coupling is a sleeve of Transite containing three rubber rings—a T-shaped middle ring and round outer rings. All of the rings are positioned within their retaining grooves at the factory. When the pipe ends move into the coupling, the outer rings are compressed making a tight and leakprof joint. The T-shaped middle ring forms a seal between the pipe ends and is designed to eliminate offsets so a smooth and continuous flow is assured.

Only two steps are required for assembling. First, a specialy prepared Johns-Manville soap lubricant is applied to a pipe end; then, the Ring-Tite Coupling is placed against it and pushed home by hand. Second, the other pipe end is lubricated, placed next to the coupling and pulled home by hand.

"American" Pipeline Mixers Now Available in Capacities From 1 to 10,000 GPM

517

American Well Works, Aurora, Illinois, has announced a new range of sizes and capacities ranging from 1 to 10,000 gpm in their "American" Homomix continuous pipeline chemical mixers.

The Homomix works right in the pipeline—mixes instantaneously at the point of entry—and provides violent, uniform and complete blending of one or more chemicals (liquid, gas or slurry) continuously or intermittently, without the use of a mixing tank. It can be easily installed in vertical, horizontal or inclined position, in any pipe line, and head loss through the unit is very low.

Butterfly Sluice Valves

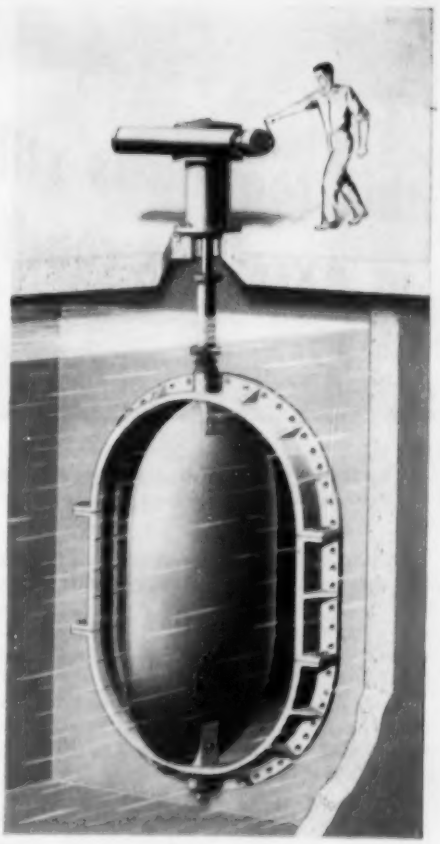
Save space . . . Fast, easy operation . . .
Save installation costs . . . Drop tight!

No "double head room" needed. The 90° rotation of the valve disc takes place entirely within the valve body . . . no additional head room is needed. Henry Pratt Butterfly Sluice Valves are the answer to the problem of valving a large flow in a minimum space.

Fast, easy operation. Even the largest of these valves can be opened or closed by one man in a few minutes.

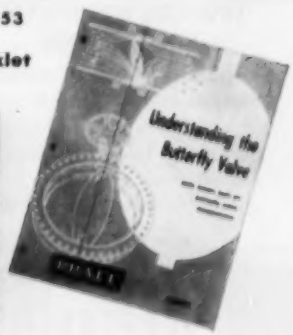
Full 90° closure into Rubber Seat. The disc is slightly larger than the inside of the rubber seat and thus actually displaces the rubber when closed. The ratio of seat thickness to disc indentation insures drop-tight shut off and avoids permanent set. The seats are secured in the valve body by removable keeper segments.

Simple, low cost installation. The entire valve is installed in one piece. There are no guide-ways to set, and thus there is no possibility for subsequent warpage to prevent tight shut-off.



SEE US AT THE A.W.W.A. CONVENTION IN CHICAGO JUNE 12 THROUGH 17, 1955, BOOTHS 52 AND 53

Send for informative booklet



HENRY
PRATT

RUBBER SEAT
Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

AFTER 28 YEARS' SERVICE—

In 1925, The Board of Water Supply, city of Providence, laid a water line in Cranston, Rhode Island. Interior surfaces were hand-brushed with hot Bitumastic® Enamel.

This illustration is graphic proof of the extra value you get when you specify Bitumastic Enamel. After 28 years' continuous service, a section of this 48-inch line was removed for inspection.

Note that there is no sign of rust or tuberculation. Brush marks are still visible. The original coefficient of flow has been maintained over the years. With such performance available from Bitumastic Enamel, there is no need to specify over-sized diameter pipe, thus giving important installation as well as operational economies.

Samples of this original 28-year-old Bitumastic Enamel lining were tested. Laboratory analysis showed there was practically no change in the characteristics of the Bitumastic Enamel. This gives every reason to believe that the line will continue to give the same type of dependable performance for many more years.

Service records like this prove that it pays to use strong steel pipe, protected by Bitumastic Enamel. It's an economical combination for your large-diameter water lines. Write for full information.

SEWAGE EQUIPMENT PROTECTION!

Koppers also makes Bitumastic® Protective Coatings for all kinds of sewage-plant equipment. Give your expensive equipment the effective protection it deserves. Write for complete data.

KOPPERS BITUMASTIC® ENAMELS

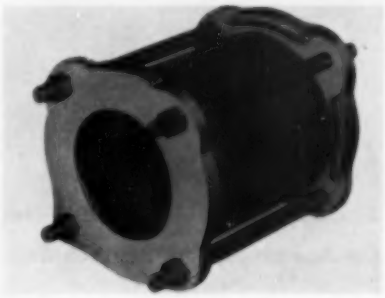
KOPPERS COMPANY, INC., Tar Products Division

Dept. 561-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

Pipe Line Adaptor Coupling

518



Johnson-Fagg Engineering Company, Tulsa, Oklahoma, has developed a new corrosion resistant line pipe adaptor coupling, designed to reduce field inventories while increasing installation convenience.

Easily installed and dismantled, the new Little Giant Adaptor Coupling is designed so one standard size fits a variety of pipe classes and materials.

This unique coupling will join cement asbestos (all classes in the same size); cement asbestos to steel; steel to steel; plastic to steel; and is also furnished with reducers of various sizes.

A bolt type coupling, this new product has cement asbestos body and high strength iron flanges. A seal is accomplished by pressure against oil resistant synthetic rubber gaskets between flanges and body. It is available in straight sizes of 3″ to 12″, and combination sizes.

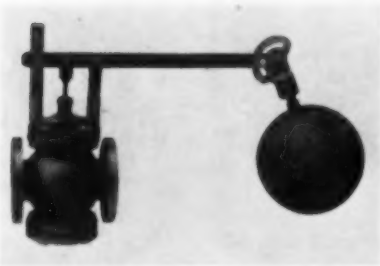
New Design For Sweco Separator

519

Southwestern Engineering Co., Los Angeles, Calif., has developed new tangential discharge spouts that replace rectangular shape spouts on SWECO Vibrating Screen Separator. Original design used rectangular spouts set at right angles to screen decks. The new tangential shape spouts permit greater efficiency and speed to develop in material as it spirals out on screen and through discharge at frame wall. Both 48″ diameter and 18″ diameter SWECO Separators carry new spout design.

Sweco Separators utilize a unique gyratory motion imparted by a vertically mounted motor. Material fed to the screen surface is separated in a vertical flow pattern. Weights attached to the motor shaft above and below the motor impart a vibratory motion to the entire screen frame assembly sitting on springs. The adjustment of these weights (in eccentric opposi-

tion) allows processors to quicken or retard the travel speed of material on the screens—thus increasing or decreasing the screening rate of particles according to the nature of the material being classified, or separated.



New Float Valve

520

Fulton Sylphon Division of Robertshaw-Fulton Controls Co., Knoxville, Tenn., has introduced a new float type valve for controlling levels of liquids.

The direct acting control, called the No. 1620 series float valve, is sturdily constructed, mainly of bronze and steel. Floats of other metals for special applications are available, the Company said.

Designed to require a minimum of maintenance, the new control can be ordered in eleven different valve sizes, from ¼" to 4". Larger sizes are supplied with a semi-balanced, double-seated valve. This valve, it was stated, is preferred for many uses, particularly for slurries or liquids containing suspended solids.

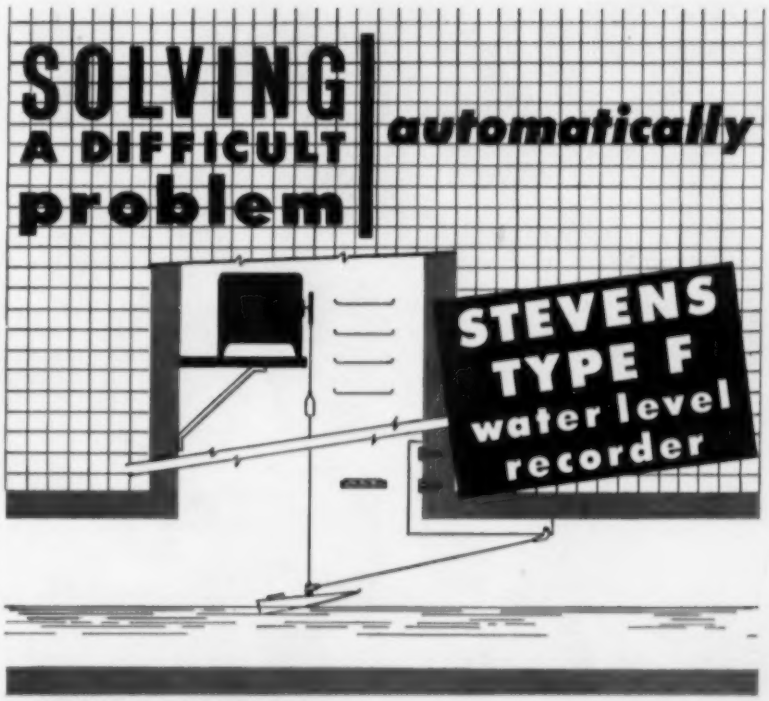
Septic Tank Cleaner

521

The FX-Lab Company, Newark, N. J., has developed a new bacterial development for sluggish septic tanks and cesspools.

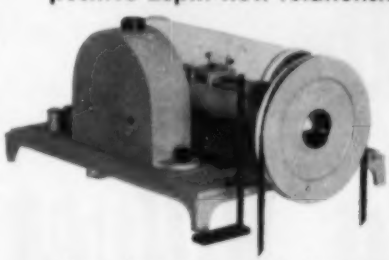
This new product, Formula FX-11, employs heavy concentrations of micro-organisms in liquid form, designed to quickly digest and break through the sludge barriers that are obstructing the toilet flow of organic waste to household disposal systems.

A sluggish system can be restored to normal efficiency by the use of this latest bacterial development if used at the first sign of backup, bubble, or slow drain off. The accelerated bacterial action clears pipes, baffles and cesspool sidewalls, and gradually liquefies undigested particles that are clogging the drainfield soil pores.



PROBLEM: To obtain automatic, graphic records of the flow of sewage in a sewer main without the expense of installing a weir and float well.

SOLUTION: Install a STEVENS Type F Water Level Recorder mounted on a bracket in a manhole. Use a scow float to operate the recorder and make a stage-discharge rating of the flow. Or, following construction details and rating tables we provide, also install a STEVENS critical flow control down stream to establish a positive depth-flow relationship.



The planning and efficient operation of any project which involves measurement of flowing liquids is based on flow data which can be obtained with STEVENS water level recorders. STEVENS instruments are at work compiling data on hydroelectric and flood control projects, and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

STEVENS DATA BOOK

...invaluable for your reference file

144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables.

Send $1.00 (No COD's)

LEUPOLD & STEVENS INSTRUMENTS, INC.

4445 N. E. GLISAN STREET • PORTLAND 13, OREGON

Foremost in Precision Hydraulic Instruments Since 1907

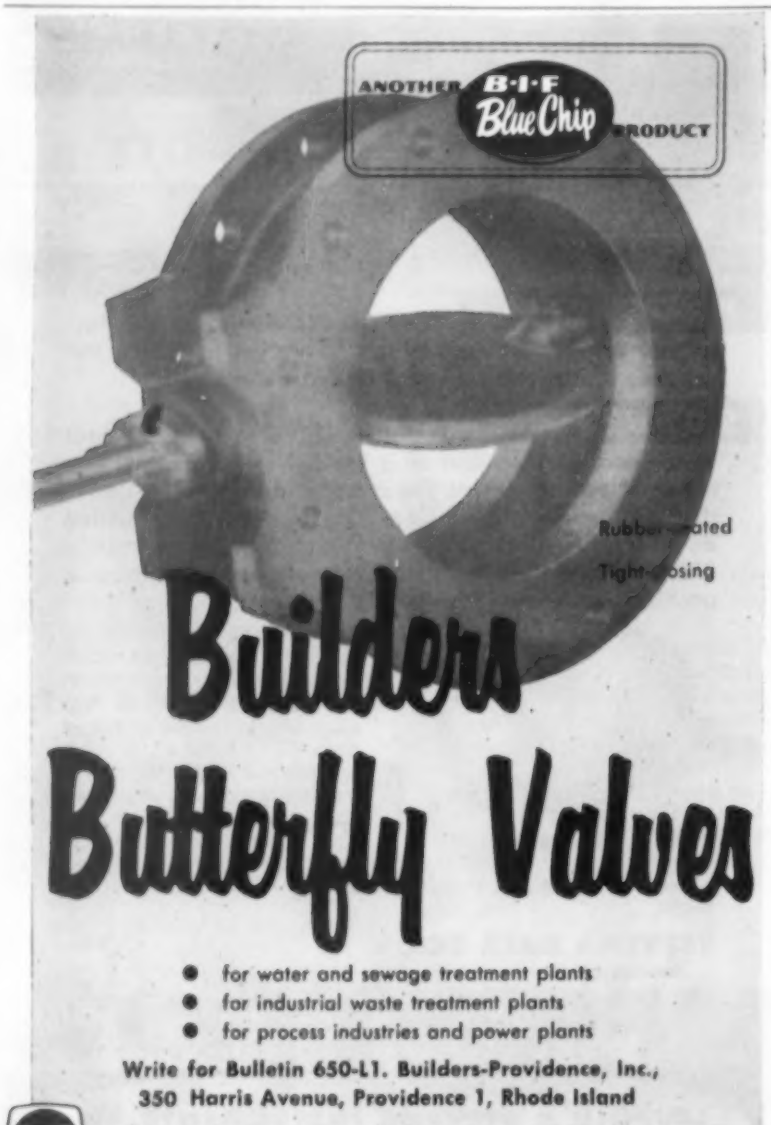
W&SW

Manufacturers' News

B-I-F Industries Elects Officials

B-I-F Industries, Inc., Providence, R. I., has announced that the following directors were re-elected at a recent meeting: H. S. Chafee, Z. Chafee, Jr., D. K. Bartlett, C. D. Mercer, Earl H. Bradley, L. E. Harper, G. W. Kelsey, I. O. Miner, John S. Chafee, H. D. S. Chafee, R. P. Lowe, and Louis H. Harvison. The directors elected the following men to the newly-created office of Assistant Vice President: W. W. Adams, Director of Sales Development; C. I. Bearse, Purchasing Agent; N. A. Larsen, Shop Superintendent; R. W. Pearce, Works Manager; and W. A. Wiggins, Director of Production Control.

Mr. Earl H. Bradley, President of B-I-F Industries, reported to the stockholders that one new corporation —B-I-F Texas, Inc.—was added last year and operates sales offices in Houston and Dallas, Texas. The major new development during the year was the line of tight-closing Butterfly Valves, which have many applications in the Water Works and Industrial fields.


ANOTHER B·I·F Blue Chip PRODUCT
Rubber-seated
Tight-closing
Builders
Butterfly Valves
• for water and sewage treatment plants
• for industrial waste treatment plants
• for process industries and power plants
Write for Bulletin 650-L1. Builders-Providence, Inc.,
350 Harris Avenue, Providence 1, Rhode Island
BUILDERS-PROVIDENCE
DIVISION OF B·I·F INDUSTRIES, INC.
METERS FEEDERS CONTROLS

Badger Meter Makes Two Appointments in Sales

Badger Meter Mfg. Co., Milwaukee, Wis., has announced that two appointments have been made in the sales organization.

R. J. ROSS

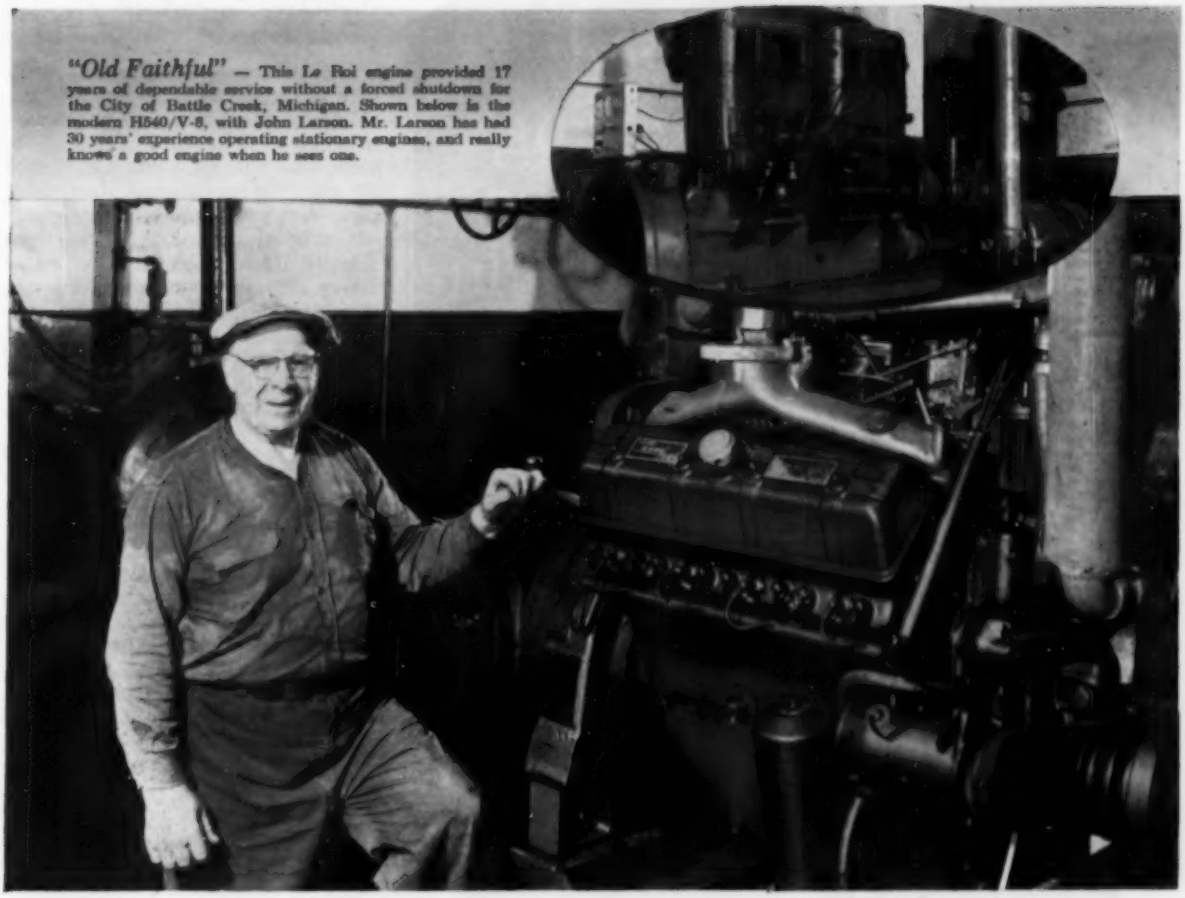
Ross J. Burns, formerly western sales manager of Badger Meter, has been named Water Meter Sales Manager. Burns, a veteran of 25 years in the field, has been headquartered in Los Angeles, Calif., and is now located in Milwaukee.

Replacing Burns on the west coast is John Way, a native of Peoria, Ill., who came with Badger in 1954 after having served as sales manager for the Contractor's Equipment and Supply Co., Albuquerque.

Philadelphia Quartz Appointments

Philadelphia Quartz Company, Philadelphia, Pa., has announced the election of additional officers—three Vice-Presidents: John C. Russell, Sales; Charles E. Ramsey, Traffic, and Thomas Elkinton, Executive and Personnel; and an Assistant Treasurer, J. Morris Evans.

The company also has appointed LeRoy R. Fischer as Sales Manager and T. Marvin Hennessy as Traffic Manager.



"Old Faithful" — This Le Roi engine provided 17 years of dependable service without a forced shutdown for the City of Battle Creek, Michigan. Shown below is the modern H540/V-8, with John Larson. Mr. Larson has had 30 years' experience operating stationary engines, and really knows a good engine when he sees one.

122,105.6 hours logged with only four overhauls

...dependable performance like this proves the value of Le Roi engines

In 1937, the City of Battle Creek installed its first Le Roi engine. Seventeen years later, when it was time to modernize, this engine had piled up the amazing total of hours shown above.

This is just one more example of Le Roi dependability. It is also proof of the excellent maintenance work performed by John Larson and his staff.

In 1954, "Old Faithful" was replaced by Le Roi's H540, a modern short-stroke V-8. The H540 normally operates at 1500 rpm, but, because of its short stroke V-8 design, piston speed is no greater than that of longer stroke, slower speed engines.

Moreover, the H540 provides new flexibility. This flexibility really paid off during flood conditions when the electric pumps were shorted out. The H540 ran up to 2100 rpm and, by so doing, carried the entire plant load for several days.

Performance during this emergency clearly indicated the advantages of the H540's short-stroke V-8 design. It proved that you get more horsepower per dollar and more horsepower per space. Other plus factors are easier servicing and easier installation.

Whether it's for continuous or standby service, or for pumps, blowers, or generators, it pays to use Le Roi engines. Le Roi power is dependable, low-cost power — power that can help ease the tax load in your community. You can get it in sizes ranging to 645 hp., or in custom generator sets from 50 to 350 KW. Write us for detailed information.

E-103

LE ROI *Division of Westinghouse Air Brake Co.*

Milwaukee 14, Wisconsin

PORTABLE AIR COMPRESSORS

TRACTAIR

STATIONARY AIR COMPRESSORS

AIR TOOLS

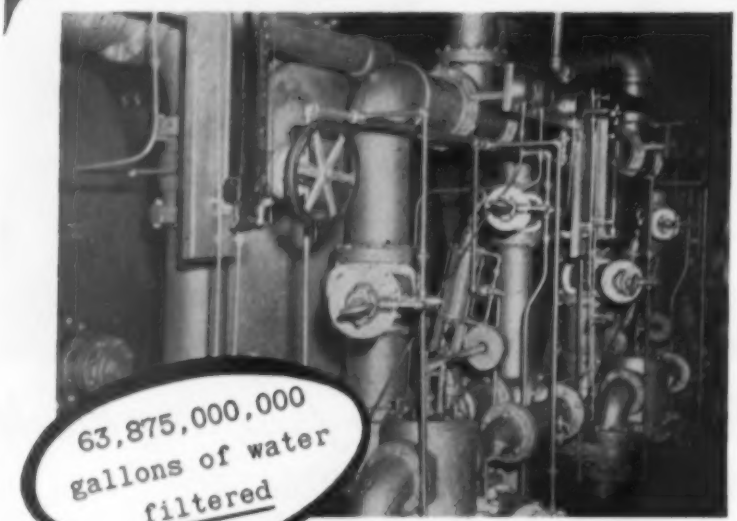
ENGINES

ON WATER CONDITIONING CONSULT AMERICAN ... first

advanced engineering is the important factor in

AMERICAN

water conditioning service



in 25 YEARS—

without replacing a single filter bed!

Twenty-six horizontal units, 8' x 20', were installed by American twenty-five years ago at the United Piece Die Works, Lodi, N. J. They have been operating every day, 24 hours a day, since then, handling 7 million gallons daily from the muddy Saddle River.

Not one filter bed has had to be replaced

Here is proof of an American design feature—an adequate underdrain system for uniform collection of filtered water and proper distribution of back wash water. American Pressure Filters are designed and built to out-perform all others. Available in both vertical and horizontal types in a wide range of sizes. *Write for copy of Booklet 400*

SERVICE SINCE 1902 — AWS PATENTED — TO THE INDUSTRY

AMERICAN *Water Softener* COMPANY

INCORPORATED

FOURTH AND LEHIGH AVENUE • PHILADELPHIA 33, PENNSYLVANIA

DEGASSERS • HOT PROCESS SOFTENERS • REACTORS • FILTERS • ZEOLITE SOFTENERS • CHLORIDE DEALKALIZERS • AERATORS & DEGASIFIERS HYDROGEN-SODIUM ZEOLITE SOFTENERS • DEMINERALIZERS • CHEMICAL FEEDERS • CONTINUOUS BLOWDOWN • SWIMMING POOL EQUIPMENT

Dorr-Oliver Centralizes Headquarters of Sales Divisions

Dorr-Oliver Incorporated, Stamford, Conn., has announced the centralization of their divisional sales headquarters at Stamford, Conn., Chicago, Ill., and Oakland, Calif., and the resulting relocation of six of these eight divisional head offices.

Center of operations of the three Eastern Sales Divisions will be at Barry Place in Stamford. Headquarters of the Eastern Industrial Division managed by R. F. Clemens was formerly located in Wilmington and the Eastern Filtration Division under the direction of T. T. Meehan was previously in New York City. On January first C. A. Knapp assumed the managerial duties of the Eastern Sanitary Division.

Previously in Evanston, headquarters of the Central Sanitary Division, with O. V. Lindell as Manager, will now be located in Merchandise Mart in Chicago. Filtration sales in this territory will be handled by the Central Industrial Division directed by R. A. Johnson. Located at Western Division headquarters at 2900 Glascock St. in Oakland will be E. D. Flynn, Acting Western Filtration Division Manager; W. T. Marston, Western Industrial Division Manager formerly in Denver; and F. G. Nelson in charge of the Western Sanitary Division, headquarters of which were previously in Los Angeles.

Bulkley, Dunton Appoints 5 New Representatives

Bulkley, Dunton Processes, Inc., New York, N. Y., has announced the appointment of five new firms as representatives for the Company's Colloidair Separator Water clarification equipment.

According to William L. Krapf, Manager of the company, the following firms have been appointed representatives:

J. L. Middleton Co., Miami, Fla., will cover the Southern Florida territory; O'brien Specialty Co., Syracuse, N. Y., will handle the complete line for the up-state New York area; Rawson & Company, Houston, Texas, will serve the Texas Gulf Coast area; R. R. Rothrock, New Orleans, La., will cover the state of Louisiana; and the Henry P. Thompson Company, Cincinnati, Ohio, with the exception of the paper companies, will represent Bulkley, Dunton in Southern Ohio.

Johnston Pump Expands

Johnston Pump Company, Pasadena, Calif., has announced a general expansion of the services and facilities of the company, and the appointment of A. H. Miller, Vice-president of Emsco Manufacturing Co. as general manager.

It was also announced that the sales engineering staff of Johnston will be increased substantially, and the dealer organization greatly expanded.

Mr. Miller comes to his new post with a broad background of experience. He started with Emsco in 1929 and moved up in the organization in various capacities.

Insul-Mastic Moving Home Office

The Insul-Mastic Corporation of America has announced the transfer of its home office from Pittsburgh, Pennsylvania to the office building of its plant in Summit, Illinois, a Chicago suburb.

The new address of the company will be 7750 West 61st Place, Summit, Illinois.

Insul-Mastic officials foresee that combining of the sales and manufacturing divisions at one central location will produce more coordination between the two and better service to the company's customers.

Acipco Promotes Five

The American Cast Iron Pipe Company, Birmingham, Ala., has announced the promotions of five key officials.

Stephen D. Moxley, former executive vice president, has been named president to succeed Charles Otto Hodges who retires after 38 years of continuous service.

Mr. Moxley is widely known for his numerous inventions such as cupola charger and flask handling device, as well as for his many articles in engineering and industrial management journals.

Others who assumed top posts at Acipco were Frank H. Coupland, who becomes vice president and works manager; Arnold J. Herrmann, who was named vice president and sales manager; Kenneth R. Daniel, vice president and chief engineer, and A. E. Bowen, treasurer.

All men have long and continuous service with Acipco and rose "through the ranks" to their present positions.

Rockwell Names Water Meter Sales Engineers

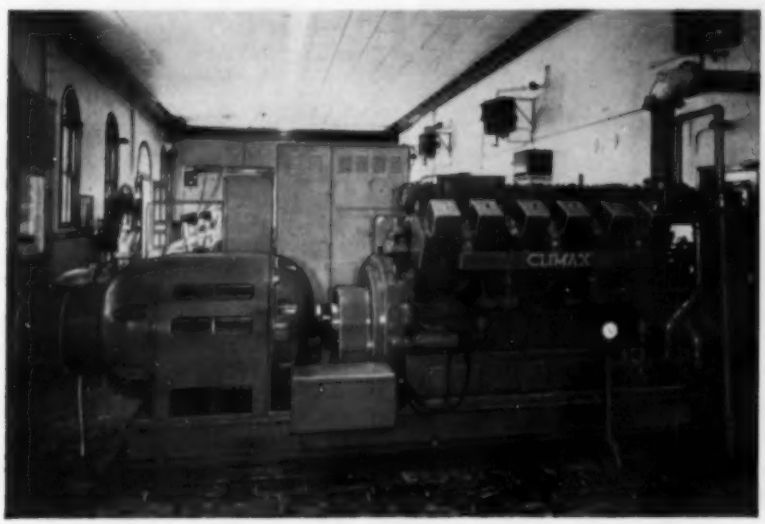
Rockwell Manufacturing Company, Pittsburgh, Pa., has announced that Edric J. Comeaux and Harold R. Strickland have been appointed water meter sales engineers at the Houston district sales office of the Company's Meter and Valve Division. The Houston office serves the states of Texas and Louisiana.

Ramey Joins R. H. Baker Co.

R. H. Baker & Company, Inc., Huntington Park, California, has announced that Harold Williams Ramey, widely known consulting engineer in the water well and oil well rigging field has been named chief engineer.

Mr. Ramey, who will direct engineering operations, has been closely associated with the design and development of piping and liquid conveying equipment for three decades. For over twenty-five years of that period, Mr. Ramey served as West Coast division engineer for the Parkersburg Rig & Reel Company.

Since 1951, Mr. Ramey was consulting engineer for the Davis Manufacturing Company of Beverly Hills, California. Mr. Ramey will assume his duties immediately at the main offices of the R. H. Baker Company located at 2070 East Slauson Avenue, Huntington Park, California.



CLIMAX . . . EXTRA POWER RELIABILITY

A Climax Engine driven generator protects the Tonawanda, New York Water Works during any emergencies.

This Water Works was recently completely electrified, with motor driven pumps replacing old steam driven pumps. To provide sufficient KVA capacity to start large motors a 625 KVA generator is required. It is driven by a Climax Model V-125, 605 HP engine which has ample capacity to furnish the KVA required for starting and the KW required after the motors are under full load.

The consulting engineer for the project was Metcalf & Eddy of Boston.

climax

FOR COMPLETE INFORMATION, WRITE TO . . .

ENGINE AND PUMP MFG. CO.

208 So. La Salle St.

CHICAGO 4, ILLINOIS

Factory–Clinton, Ia. *District Office*–Dallas, Tex.

Byron Jackson Elects Four New Vice Presidents

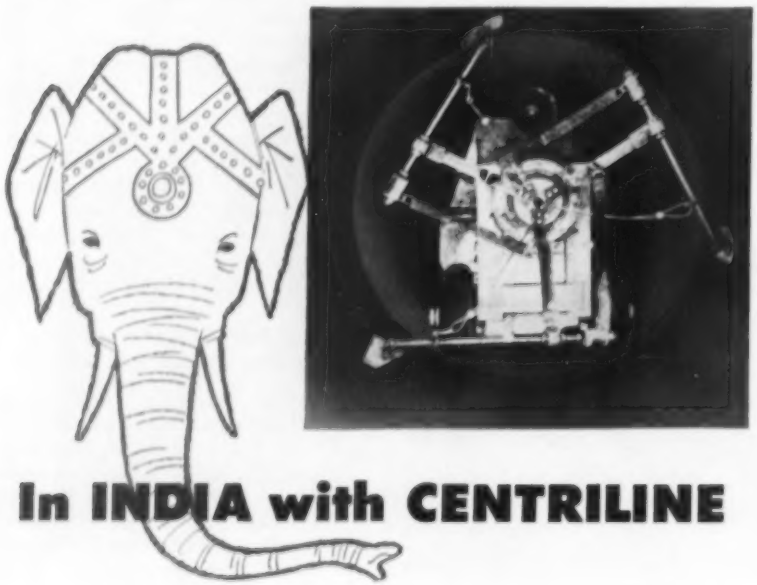
Byron Jackson Co., Los Angeles, Calif., has announced the election of four new vice presidents.

Norman D. Jesse was made Vice President in charge of sales, service and branches of the Pump Division. Mr. Jesse has been with the company since 1939 and is now manager of the Eastern branch of the Pump Division with headquarters in New York.

Garth F. Nicolson becomes Vice President in charge of the Oil Tool Division. Mr. Nicolson joined the company in 1934 and served as chief engineer of the Oil Tool Division, rising to General Manager of that division prior to his recent election as a vice president.

Evan H. Sweet is appointed Vice President and Counsel. He has been associated with Byron Jackson Co. since 1945 and was office legal counsel until his recent appointment.

Ross Barrett has been made Vice President in charge of public relations, advertising and market research. Mr. Barrett joined the company in October, 1954 as Director of Public Relations.



In INDIA with CENTRILINE

On the coast of India, the Burma-Shell Refining Company has used the Centriline process on over 21,000 feet of sea-water cooling pipe. Through Centrilining, a cement-mortar lining is centrifugally sprayed on the pipe walls. Corrosion and tuberculation are eliminated . . . pumping costs are lowered . . . flow is increased . . . maintenance becomes negligible . . . and pipe life is extended indefinitely. This particular project in Bombay called for the Centrilining of 32" I.D. and 36" I.D. new steel pipe with 5/16" lining. But Centrilining works wonders in old pipes as well—with a minimum of surface traffic interruption. Proof of the pudding is in our files—the ever increasing number of repeat contracts from municipalities, industries and contractors. Why not follow their lead. Look to Centriline to rejuvenate *your* water supply systems.

Lummus Company, India, was engineer and constructor on this project. Asiatic Petroleum Corp. was buyer for the owner.

CENTRILINE CORPORATION

A subsidiary of the Raymond Concrete Pile Company

140 CEDAR STREET
NEW YORK 6, N. Y.

Branch Offices in Principal Cities of the United States and Latin America

• CEMENT-MORTAR LINING OF PIPES IN PLACE •

National Gypsum Appoints C. J. Lewis

National Gypsum Company, Buffalo, N. Y., has announced the appointment of Mr. Clifford J. Lewis as Sales Engineer. He will specialize in the application of Gold Bond lime and limestone products for water treatment and waste disposal.

Mr. Lewis is a registered professional chemical engineer with degrees in both chemistry and metallurgical engineering. He was formerly Ass't Dir. of the Colorado School of Mine Research Foundation, served on the Pollution abatement Committee of the Pennsylvania State Chamber of Commerce, and while at Mellon Institute in Pittsburgh was associated with much of the fundamental research on the application of lime to acid neutralization problems.

Pittsburgh - Des Moines Appoints Fauntleroy

Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., has announced the appointment of Thomas W. Fauntleroy as assistant general sales manager. His headquarters will be in Pittsburgh.

Mr. Fauntleroy has been in the company's Sales Department since 1949, working from the Pittsburgh office and also assuming a number of special assignments on a nationwide basis. Since he joined Pittsburgh-Des Moines in 1946 he has served in Engineering, Drafting, Design and Fabricating Departments in addition to his sales activities.

Kaufman Promoted By Hagan Corp.

Hagan Corp., Pittsburgh, Pa., has announced that Charles E. Kaufman has been appointed manager of a newly-created chemical product development department for the Corporation and its subsidiaries, Calgon, Inc. and The Buromin Company of Pittsburgh, Pa.

The product development department under Mr. Kaufman's supervision will be responsible for the introduction and the field testing of new chemical products and equipment for industrial, commercial and residential use, with major emphasis on water conditioning.

Mr. Kaufman, formerly director of research for Hall Laboratories, Inc., another Hagan subsidiary, joined the company as a research engineer in 1936 after his graduation from the University of Cincinnati.

Armco Expands Ohio Plant

Armco Drainage & Metal Products, Inc., Washington Court House, Ohio, has announced plans for a half-million dollar expansion program at its fabricating plant.

The Washington Court House plant is the largest in a network of 49 Armco Drainage plants scattered throughout the U. S. and Canada.

The $500,000 expansion will add 44,000 square feet of working space and a large amount of new fabricating equipment to the present plant.

The present plant buildings will be enlarged and for one extension an entirely new type of wide-span structure of Armco design will be used. All building materials will be steel and fabricated by Armco Drainage.

Chemical Fire & Rustproofing Appoints Wallace

Chemical Fire & Rust Proofing Corp., Long Island City, N. Y., has announced the appointment of Mr. Elwood Wallace as Vice President in charge of gunite construction and centrifugal mortar lining of water pipes.

Mr. Wallace, well known in the field as an authority in the field on gunite and prestressed construction, was for many years with the Preload Co., New York.

Graver Appoints New Sales Representative

Graver Water Conditioning Co., New York, N. Y., has announced the appointment of the Frontier Engineering Services Co. of Salt Lake City, Utah as new representatives. Their territory consists of the northern and western parts of Wyoming, most of Nevada and all of Utah.

This organization which can be reached through P. O. Box #1772, Salt Lake City, will handle Graver's complete line of Industrial, Municipal and Industrial Waste treatment equipment.

Seitz Joins American Water Softener

American Water Softener Company, Philadelphia, Pa., has announced that Robert L. Seitz has joined the Philadelphia sales office as sales engineer.

Mr. Seitz is a chemical engineer and, prior to coming to American, has been connected in a sales capacity with Cochrane Corporation and Infilco.

Brna Joins Rhodia

Rhodia, Inc., New York, N. Y., has announced the appointment of Paul Brna as its engineering representative in the Mid-Continent area. He is a trained specialist in the application and sale of essential oils, flavors, aromatic chemicals, and organic chemicals for the industrial reodorants field.

Mr. Brna is a graduate chemist from Valparaiso University and holds an M.S. degree in chemistry from Loyola University. For eight years he was chief chemist for The Chicago Pharmacal Co., spent six years in sales work with Magnus, Mabee & Reynard, and was associated with Roubechez, Inc., before joining Rhodia.

Precision Chemical Pump Moves Office and Plant

Precision Chemical Pump Corporation—formerly Precision Machine Company of Somerville, Massachusetts—has just moved into new offices and plant at 1396 Main Street in Waltham, Massachusetts.

Their new facilities will permit them to increase production of their line of hypochlorinators, chemical pumps and accessories.

Pekrul Grows

To keep pace with the ever increasing demand for PEKRUL GATES over half a century, MORSE BROS. MACHINERY has just completed an extensive modernization program. The installation of many new machines and facilities, an increased engineering staff, and complete, new, custom re-tooling specifically for PEKRUL GATE production means...

modern design and superior engineering service...

even faster PEKRUL GATE deliveries to you...

PEKRUL GATE DIVISION

MORSE BROS. MACHINERY
DENVER, COLORADO

MANUFACTURERS OF PEKRUL GATES FOR

Flood Control · Sewage Disposal · Roaring Ponds · Recreation Pools
Levees · Reservoirs · Irrigation · Cooling Towers · Pumping Plants
Water Works · Oil Refineries · Steel Mills · Dams · Fish Hatcheries

DAM REPAIRED WITH "GUNITE"

The two photographs show the Bulls Bridge Dam of the Connecticut Light and Power Company, which is one of many dams we have repaired for this company.

The upper view shows the work in progress, and gives some idea of the condition of this structure before repairs were made. The lower view is of the completed job.

After chipping out the loose and disintegrated concrete and sandblasting the entire area, heavy reinforcing mesh was placed over the surface of the old concrete and "GUNITE" applied two inches thick, plus the material required for filling deeply eroded portions.

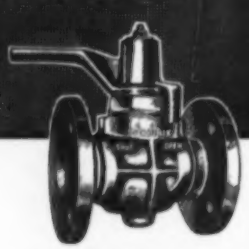
Our 72-page bulletin C-3000 describes scores of similar "Gunite" jobs.

Write today for bulletin C-3000

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE "CEMENT GUN"

LONG-LASTING, TROUBLE-FREE
DEZURIK VALVES....



THE DRIP-TIGHT ANSWER TO VALVE PROBLEMS!

Here's the EASY-OPERATING, NON-LUBRICATED valve that ends constant valve maintenance problems. DeZurik Valves require no lubrication. They're the only valve with an eccentric-shaped, rubber-faced plug. They open wide—*full pipe*—or shut tight—*drip free*—with an e-a-s-y quarter-turn. Manufactured in sizes from ½" thru 20", they're available in manual, remote and automatic operated models.

Write for complete details and service recommendations on DeZurik Valves. Representatives in all principal cities.

DEZURIK SHOWER CO. SARTELL, MINN.

Koppers Names New Chairman, President

Koppers Co., Pittsburgh, Pa., has announced that W. F. Munnikhuysen has been elected Chairman of the Board and Fred C. Foy was named President and chief executive officer.

Election of Mr. Munnikhuysen and Mr. Foy fills the vacancies created by the death last February 13 of General Brehon Somervell, who had been both Chairman and President. General Somervell died unexpectedly in Florida where he had gone for a rest.

Mr. Munnikhuysen has been Executive Vice President of Koppers since 1950. Previously he had been Vice President and General Manager of the Company's Wood Preserving Division. He first joined the Company in 1916.

Mr. Foy, who joined Koppers in 1948, has been Vice President and General Manager of the Company's Tar Division since 1950, and a member of the Company's Board of Directors since last May. For the past six months he has been on special assignment to the President's office while retaining his duties in the Tar Products Division. He was also elected a member of the Executive Committee of the Board of Directors.

Members of the Board today also elected R. R. Holmes as Vice President and General Manager of the Tar Products Division, succeeding Mr. Foy. Mr. Holmes, who joined Koppers in 1923 has been a Divisional Vice President and Assistant General Manager of the Division.

Bulkley, Dunton Appoints New Representatives

Bulkley, Dunton Processes Inc., New York, N. Y., has announced the appointment of H. E. Danby Company, Inc. of Indianapolis, Ind., Nicholas A. D'Arcy, Jr., of Huntington Park, Calif., W. H. Davidson Company of Wayne, Pa., and John D. Homan of Tampa, Fla., as the sales agents and representatives of Bulkley, Dunton in their representative territories.

The Danby Company will cover all industries except paper in Indiana, D'Arcy will serve the petroleum industry in Southern California, Davidson Company will call on all general industry in eastern Pennsylvania, Southern New Jersey, and Delaware while Homan will represent Bulkley, Dunton in Northern Florida.

Flavin Appointed V. P. By Johns-Manville

Johns-Manville Corporation, New York, N. Y., has announced the appointment of Edward D. Flavin as Vice President of the Johns-Manville Sales Corporation and Manager of Special Industries, Industrial Products Division.

Mr. Flavin succeeds L. A. Baldwin, who retires after a 35-year career with the Company.

Mr. Flavin attended Syracuse University and served as an engineer with several corporations prior to joining J-M in 1929 as a sales representative in the Syracuse District. He was made Ass't. District Manager of the New York Industrial Products Division in 1939 and in 1946 was appointed New York District Manager. In 1953, he was promoted to Ass't. Manager, Special Industries Department of the company's Industrial Products Division.

Mueller Appoints New Sales Reps.

Mueller Co. Sales Div. has announced the appointment of two new sales representatives.

Robert R. Lugo, Jr., who since August, 1953, has been an order interpreter in the sales office of the Los Angeles plant, has been assigned to cover a part of the Los Angeles area and portions of Southern California extending to the Arizona and Nevada borders.

John T. Leahy, assistant to A. O. Yonkers, assistant sales manager in charge of water products at the Decatur office, will travel the Southern Illinois territory.

Both territories are newly created, each having previously been a part of a large area covered by a single representative.

Stockdale Appointed President Of Insul-Mastic

Insul-Mastic Corporation of America, Summit, Illinois, has announced that Mr. H. L. Stockdale has been appointed president of the company. Mr. Stockdale succeeds Mr. Clifford Off.

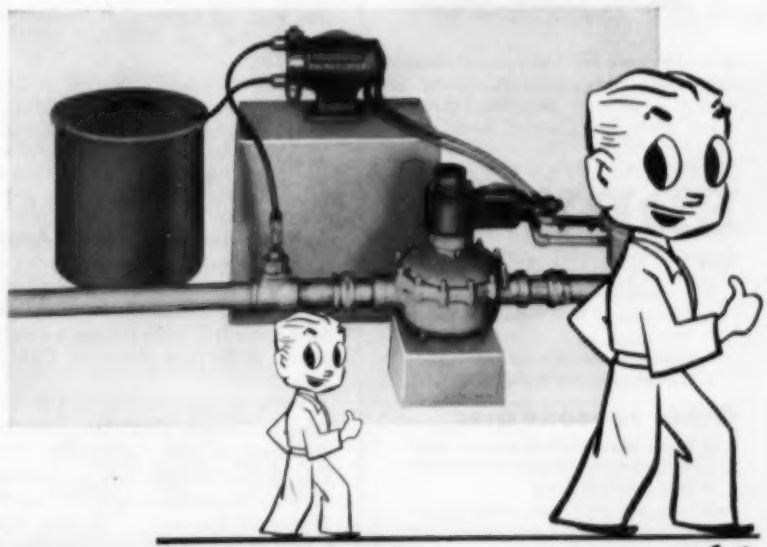
Mr. Stockdale comes to Insul-Mastic from outside the company ranks. However, he was at one time manager of the Houston branch of this company. While in Houston he became associated with the Industrial Waterproofing Company, well known coating contractors on the Gulf Coast. There he rose to the presidency of that concern.

De Laval to Build New Pacific Headquarters

De Laval Steam Turbine Company, Trenton, N. J., has announced that construction has started on the new $500,000 Millbrae, Calif., headquarters.

The new building will house both the De Laval Turbine Pacific Co., now at 160 Folsom St., San Francisco; and the De Laval Pacific Co., now at 61 Beale St., San Francisco.

The 2.7 acre site at 201 E. Millbrae Ave., in the Millsdale Industrial Park, will house the following operations: the assembly of De Laval Centrifugal pumps, repair and service operations, manufacturing of industrial filters and general warehousing for both firms. The office building will be of conventional construction, with stucco walls.

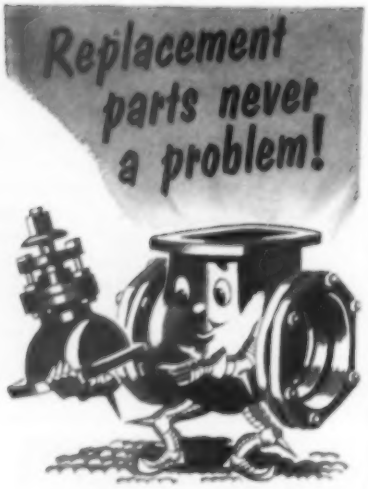


FEED RATE FOLLOWS FLOW RATE *Automatically*

For treating gravity fed water supplies, here's a natural. The only power required to drive Proportioneers Automatic and Proportional Chem-O-Feeder is the flow of water through the pipe line itself. The Chem-O-Feeder delivers water treating chemicals in strict proportion to the main flow: low flow . . . low feed — high flow . . . high feed.

Simple and dependable, the Chem-O-Feeder is paced by a standard main line, by-pass, or fire line meter — and is easily adapted to most any meter already in service. The meter does not drive the pump but serves simply as a control unit — thus the accuracy of the meter itself is in no way impaired. Bulletin SAN-6 gives complete details . . . send for your copy today. Proportioneers, Inc., 350 Harris Avenue, Providence 1, Rhode Island.

PROPORTIONEERS
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.
BIF METERS FEEDERS CONTROLS



Backed by more than 100 years of successful operations, Eddy Valve Company has always maintained interchangeability of repair parts. That's one of many reasons why thoughtful, "look-ahead" engineers and purchasing agents specify . . .

EDDY valves for:

- Extensions and New Installations.
- Installation of New Valves in existing lines.
- Replacement of worn-out valves.
- Shut-off Valves for hydrants.

Other reasons are:

- Taper seats provide positive, self-wedging action, assuring no-leak closing.
- Only 3 moving parts.
- Even new employees without special training can service and maintain any Eddy Valve.
- Available with standard or "O"-Ring packing.
- Furnished with bell, flange or mechanical joint connections to fit any existing or planned installation.
- 105 years of successful operations assure availability of repair parts.
- Conform to all A.W.W.A specifications.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons
WATERFORD, NEW YORK

Dorr-Oliver Opens New Offices In Chicago and Cleveland

Dorr-Oliver Incorporated, Stamford, Conn., has announced the relocation of their Chicago office in Merchandise Mart and the opening of a new office in the Midland Building in Cleveland. The new office in Chicago provides a central location for operations in that territory and the new Cleveland location will allow Dorr-Oliver to better serve engineers and industry in the Lake Erie area.

Staff formerly located in both Chicago and Evanston will be housed in the new Chicago office. It will serve as headquarters of the Central Sanitary Division managed by O. V. Lindell and the Central Industrial Division under the direction of R. A. Johnson.

R. R. Denison, Central Industrial Sales Engineer, and J. N. McKenna of the Central Sanitary Division will staff the office in Cleveland.

Jensen Joins B-I-F in Los Angeles

B-I-F Industries, Inc., Providence, R. I., has announced the appointment of Kenneth Elvin Jensen as serviceman for the Los Angeles, California area.

Prior to his joining B-I-F Industries in March 1952, Mr. Jensen was employed by the Caterpillar Tractor Co. of Peoria, Illinois. A graduate of Ruskin High School, Hickman Mills, Missouri, he served in the Marine Corps as a combat radio operator in Korea. Mr. Jensen will work out of the B-I-F Pacific, Inc. office in Los Angeles.

De Laval Appoints Bixby Sales Manager

De Laval Steam Turbine Company, Trenton, N. J., has named D. T. Bixby as Sales Manager of its Standard Products Division with headquarters in Trenton.

Prior to his new post, Mr. Bixby served as Sales Manager of De Laval's Seattle District office, and since joining the Company in 1945 as sales engineer he has served in the Trenton and San Francisco sales offices.

FOR MAKING SERVICE CONNECTIONS QUICKLY, EASILY!

SKINNER-SEAL SERVICE SADDLE

For steel, cast iron and Transite pipe. Single massive bolt. Sizes 1" to 12" inclusive. Write for catalog.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA

HEAVY-DUTY ELLIS PIPE CUTTER
FOR CUTTING LARGE SIZE PIPE

Drop-Forged Frame and Links

Long-Lasting Cutter Wheels

Makes a Hit With Water Works Men

Cuts Pipe in or Out of Ditch

TWO SIZES
No. 01 for 4" to 8" Pipe
No. 1 for 4" to 12" Pipe

Write for Circular and Price List No. 35WS

ELLIS & FORD MFG. CO.
FERNDALE 20, MICH.

W&SW

New Literature

Vertical Hollow Shaft Motors

522

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has just published a bulletin describing the construction features of the company's open type **Vertical Hollow Shaft Motors** for outdoor service in ratings from 2 to 125 hp.

According to the bulletin, the motor is available with self-release coupling, ball-type non-reversing clutch, rigid coupling, or without coupling. Details of each construction are shown in the bulletin. A neoprene O-ring seal between the cover and frame prevents dirt from getting into the coupling and bearing chamber. Also included in the bulletin is a horsepower frame chart.

String Discharge Filters

523

Filtration Engineers, Inc., Newark, N. J., has just published a bulletin on **FEinc Rotary Vacuum Filters.**

The bulletin discusses the principles of operation, performance characteristics and other technical details of continuous rotary vacuum filters with the FEinc string discharge. Clearly illustrated text explains how the rotary vacuum filter operates, and many applications in the processing of industrial wastes, sewage, paper and pulp, etc., are shown.

FEinc horizontal rotary vacuum filters, FEinc scraper filters, and FEON synthetic filter fabrics are also briefly described.

Water and Waste Conditioning Equipment

524

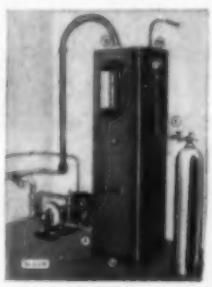
Graver Water Conditioning Co., New York, N. Y., has released a bulletin on **Equipment for All Water and Waste Conditioning Processes.**

The bulletin presents a concise discussion of the basic types of equipment available for treatment along with photographs of typical installations. The advantages of industrial waste treatment are presented, as well as the types of municipal equipment available.

Water Works Engineer's Check List

525

B-I-F Industries, Inc., Providence, R. I., has issued a **Water Works Equipment and Instrumentation Check List** for engineers. Illustrated with photographic flow diagrams, this check list classifies and locates primary measuring elements, secondary instruments, chemical feeders, and controls in relation to processes and measured variables.



TYPICAL INSTALLATION WITH BOOSTER PUMP ON WATER SUPPLY

HIGH VACUUM
SOLUTION FEED
DEPENDABLE
ECONOMICAL

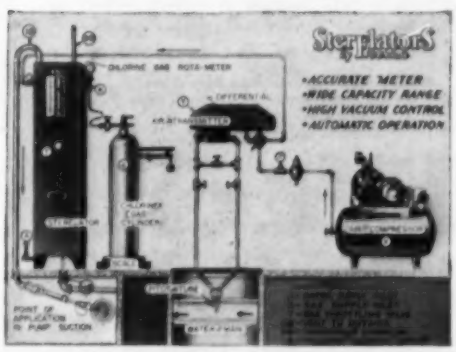
WATER WORKS
SEWAGE TREATMENT

SterElators by Everson

CHLORINE GAS CONTROL EQUIPMENT

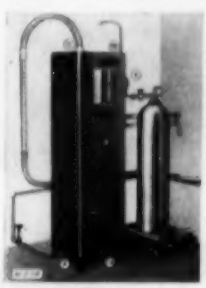
THE EVERSON AIR-O-MATIC SYSTEM

FOR AUTOMATIC PROPORTIONING OF GAS FEED TO LIQUID FLOW



METER AND CONTROL CHLORINE GAS
IN THE NON-CORROSIVE STATE

RATIOS 10 TO 1—50 TO 1—110 TO 1
VISIBLE FLOW INDICATION



TYPICAL INSTALLATION SHOWING SCALE

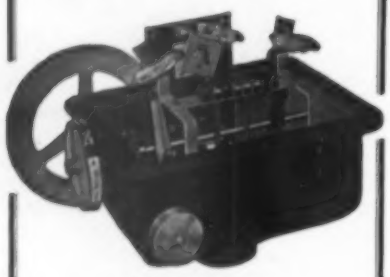
ANY ONE CAN INSTALL
EASY TO OPERATE
LOW
MAINTENANCE
COSTS

INDUSTRIAL PLANTS
SWIMMING POOLS

Everson Manufacturing Corporation 233 West Huron Street Chicago 10, Illinois

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

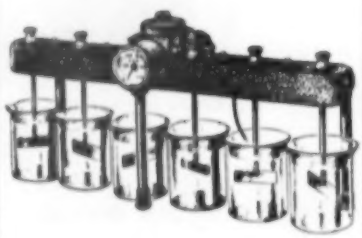
Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

783 HAMPDEN AVE., ST. PAUL 4, MINN.

P&B Multiple Stirrer



When several samples are mixed simultaneously under identical conditions the optimum concentration of flocculent may be quickly selected and translated to plant quantities . . . The mixer takes 1,000 ml. beakers. Speeds from 15 to 100 r.p.m. are standard.

Write: Cat. No. 77-700

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

Low-Capacity Chemical Feeders

526

Proportioneers, Inc., Providence, R. I. has issued a bulletin on **"The Chlor-O-Mite-Low Capacity Chemical Feeders, Models E and H."**

This two-page Color Bulletin shows the feeders and typical arrangements for constant rate, intermittent, flow-proportional and hydraulic pulse feeding.

According to the bulletin the "Chlor-O-Mite" is offered as a packaged unit, and is an electrically- or hydraulically-operated diaphragm-type feeder. Specifically designed for controlled feeding of hypochlorite or other water treatment chemical solutions, this unit is ideally suited to small water systems operating at not over 25 gallons per minute. Low first cost, easy installation and minimum maintenance are its main advantages.

Water Sewage and Waste Treating Equipment

527

Hardinge Company, Inc., York, Pennsylvania, has just published a completely new twenty-page catalog on their line of equipment for **Water, Sewage and Industrial Waste Treatment.** The catalog shows details of construction and specifications for Hardinge Circular Clarifiers, up to 200' diameter, and Hardinge Rectangular Clarifiers with crane type scraping mechanism. It also briefly describes Hardinge Digesters and Automatic Backwash Sand Filters.

Equipment applications discussed in the catalog include municipal sewage treatment, municipal and industrial water treatment and industrial liquid waste treatment, connected with coal washeries, steel plants, pulp and paper plants, sand and gravel plants, and oil refineries.

Flotation Unit

528

Graver Water Conditioning Co., New York, N. Y., has released a new bulletin on the **Aeroflotor,** a new Flotation unit.

The bulletin discusses the principles behind the design of the unit, its operation and its special features.

The Aeroflotor has particular application in the paper and pulp industry, oil industry, food processing, water re-use as well as many other fields.

Your Best Source for

SWIMMING POOL & WATER TREATMENT SUPPLIES & EQUIPMENT

Since 1935, contractors, engineers and water supply departments have regarded *Modern* as their most economical source for all equipment and supplies for swimming pools, lakes and reservoirs. *Modern* manufactures filters, anti-algae and other water treatment chemicals, swimming pool paint, pool fittings and equipment—*100 top-quality products.* Complete line, huge stocks and nation-wide distribution assure fast shipment.

Send for free catalog 15-E *today!*

modern

SWIMMING POOL CO., INC.

ONE HOLLAND AVENUE

WHITE PLAINS, N. Y.

Tough and Strong LASTS EXTRA LONG

KONIK metal beats the rigors of a tough culvert life—it resists rust and fights element corrosion. The Continental open hearth steel plus copper, nickel and chromium does it. These sheets are made especially for culvert use because they stand more rough abuse. Continental Steel Corporation, Kokomo, Indiana.

ASK TO SEE THE KONIK CULVERT METAL WARRANTY

Continental culvert distributors are glad to show the KONIK warranty . . . and the certified analysis that assures the longer culvert life of KONIK metal.

CONTINENTAL STEEL CORPORATION

FENCE • BARBED WIRE • POSTS • NAILS • ETC.

Swimming Pool Data Book

529

Modern Swimming Pool Co., Inc., White Plains, N. Y., has just released a new **Catalog and Data Book** of water-treatment chemicals, swimming pool supplies and equipment. This 44-page book, profusely illustrated, contains data, photographs and prices of every item needed to build an indoor or outdoor swimming pool, or to equip and maintain an existing pool. There is a section on proper pool care and maintenance, and detailed descriptions of approved water-treatment chemicals. "Berkite," the new fast-acting chemical for the control of algae in lakes and reservoirs, is included in this section.

This data book is designed to be helpful to engineers, architects and contractors and to municipal purchasing agents interested in economical sources of supply for water-treatment chemicals and swimming pool equipment. It gives working drawings, descriptions and prices of a complete range of swimming pool equipment, including filter systems, plumbing fittings and pool ladders. There are photographs, detailed descriptions and illustrations of underwater floodlights, pool vacuum cleaners, observation windows, chlorinators, automatic skimmers, diving boards and stands—and every other item needed in pool construction and maintenance.

The Victaulic Method Of Piping

530

The Victaulic Company of America, Union, N. J., has available a 36-page catalog-manual on the **Victaulic Method of Piping.**

The manual presents complete data on the company's snap-on and bolted clamp-type couplings for installation of steel, spiral, wrought iron, cast iron and other pipe with grooved ends, collared or shouldered ends, or plain ends. For steel and other IPS pipe, these couplings are supplied in sizes from ¼ to 30 inches. For cast iron pipe they are supplied in sizes 4 through 60 inches.

Also presented are complete details on Victaulic pipe fittings, readily installed with Victaulic couplings and supplied in a wide variety of styles in straight and reducing sizes, and data on portable Vic-Groover tools for on-the-job cutting and grooving of pipe.

Motor Buying Information

531

General Electric Company, Schenectady, New York, has just published a new 28-page catalog of **Buying Information on A-C Motors.**

The bulletin presents complete buying information on standard a-c fractional and integral horsepower motors in most general use. Included are general- and definite-purpose fractional horsepower motors, and fhp gear motors.

A special section on the selection of integral horsepower motors covers horsepower requirements, enclosures, starting current limitations, speeds, motor types, and selection of fuses and circuit breakers. Descriptions and specifications include single-phase, poly-phase, totally enclosed fan cooled, and gear-type integral horsepower motors.

Information on all motors includes photos, ratings, book prices, dimensions, weights, frame numbers, and standard modifications.

Hardinge CLARIFIERS for rectangular tanks

Three Hardinge primary clarifier units in 22' x 68' x 17' tanks at the municipal sewage disposal plant in York, Pennsylvania. Other Hardinge equipment in this plant—final clarifiers, sludge thickener and digesters. (Albright & Friel, Consultants)

Hardinge has installed more than 70 rectangular clarifier units for municipal sewage treatment, oil refinery wastes and miscellaneous industrial liquid wastes—processing in excess of 300 million gallons of liquid daily.

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Filter Fabrics Booklet

532

Wellington Sears Company, New York, N. Y., has just published a 16-page illustrated booklet on filter fabrics, entitled "**Filter Fabric Facts.**" While the booklet makes no claim to being a complete technical manual, it summarizes a number of general and specific facts about this specialized subject which are not believed to have been generally available to the processing industries in any one publication before.

Based on Wellington Sears' fabric development files and the experience of specialists in various aspects of filtration, this booklet contains information about filtration principles; filtering devices; filter media; textile fibers for filtration; a comprehensive chart on chemical and heat resistance of cotton and synthetic fabrics; sections on yarns, fabric construction and finishing; and a round up of filter fabrics in use. Among the many illustrations are photographs of a few examples of the tremendous variety of filter fabrics being produced for industrial customers by the mills of West Point Manufacturing Company, Wellington Sears' parent organization.

Soda Ash Slurry Storage Systems

533

Diamond Alkali Company, Cleveland, Ohio, has just published a booklet, entitled "**A Digest of Diamond Alkali's Dollar-saving Soda Ash Slurry Storage Systems.**" The booklet concisely yet comprehensively explains how plants can effect economies in storing and handling soda ash in readily usable form as a slurry.

A number of other important advantages that contribute to more efficient handling and lower-cost storage of this chemical are also discussed. In addition, pneumatic and mechanical methods developed by Diamond for unloading, handling and storing soda ash are briefly described and schematically illustrated.

Pneumatic Control and Transmission Systems

534

The Industrial Division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., has published a new handbook-type bulletin on **Pneumatic Control and Transmission Systems.** It describes pneumatic controllers, their applications and how they work.

The bulletin also describes pneumatic transmission systems and cascade, ratio and other interconnected control systems. Besides this information for the industrial designer, the bulletin also contains practical information for the plant operators on how to tune pneumatic controllers to a process, how to introduce manual adjustments and how to provide the best air supply.

Treating Village Water Supplies

535

Builders-Providence, Inc., Providence, R. I., offers an **Application Memo** on how its equipment continuously meters and chlorinates well water supplies providing efficient, economical, automatic proportioning of chlorine and continuous recording of water consumption.

This bulletin also contains a clear, easy-to-read flow diagram showing a typical installation.

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Wrought Iron Pipe
536

A. M. Byers Company, Pittsburgh, Pa., has just published a **"Wrought Iron Pipe Catalog."** This 52-page manual contains the technical information most frequently required by architects, engineers, piping contractors, builders, maintenance superintendents and other specifiers of piping and tubing.

More than 25 separate tables list size and dimensional data of wrought iron pipe and tubular products. Other tables record dimensions of pipe in fractions of an inch, decimals of a foot equivalent to inches and fractions of an inch, and decimal equivalents of fractions of an inch.

Data is also provided about wire and sheet metal gages, flow of water in gallons per minute and useful conversion factors.

The individual tables include size and dimensional data for standard weight pipe, extra strong and double extra strong pipe, standard weight threaded line pipe, butt-welded standard weight plain end line pipe and lapwelded regular weight plain end line pipe, butt and lapwelded extra strong plain end line pipe and large outer diameter pipe.

Pump Brochures
537

Bingham Pump Company, Portland, Oregon, has published an informative 16 page brochure **"This is Bingham Pump"** describing facilities and methods used by the company in the manufacture of Centrifugal, Turbine, Propeller, Hi-Press, Condensate and Vacuum Pumps. The company manufactures pumps for many industries.

The company also offers a companion 32 page brochure **"A Technical Treatise on the Advancement of Centrifugal Pump Design,"** giving an engineering description of the "Bingham Double Volute" design.

Diatomite Filter Operations
538

General Filter Company, Ames, Iowa, has just published a 2-color, 4-page bulletin on **How the Diatomite Filter Works.**

The bulletin, by means of drawings and descriptive text, clearly shows the three necessary steps; precoating, filtering and cleaning.

Automatic pH Control Eliminates Red Water
539

Beckman Instruments, Inc., Fullerton, Calif., has available a **Data Sheet** that gives the case history of how the installation of automatic pH control has saved the Macon Water Works, Macon, Ga., $1500 annually in alum alone, eliminated "red water" completely, reduced the turbidity from 8-12 ppm to 1-2 ppm, and saved 100,000 gallons of blow off water per day.

Pipe Detector Manual
540

Detectron Corporation, North Hollywood, California, has just released a new **Operating Instruction Manual** for pipe detecting instruments.

Although the manual was written chiefly for the Detectron Model 505, it is amply illustrated and contains operating hints and other information useful with any make of pipe detector.

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Valve Remote Control Systems

541

The Stow Manufacturing Co., Binghamton, N. Y., has just printed a 20 page Design Manual for **Valve Remote Control Systems.** Flexible shafting, standard terminals for reach rods, and geared joints for any valve control installation, can now be selected from one design manual.

The section on flexible shafting contains a chart for selecting the correct size flexible shaft knowing the length of the shaft and the size of the valve handwheel. A finding diagram shows the different type valve couplings, intermediate connections, remote stations, and clamps that are available for flexible shafting. Drawings of the terminals are shown with complete dimensional data.

The section on Rigid Rod controls also has a finding diagram showing the different valve couplings, universal joints and remote stations available for reach rod controls. Drawings with dimensions are shown for these terminals, also.

Detailed data on the new 360° geared joint is given which is available for connecting to reach rods or flexible shafting.

Mechanical Screens

542

Link-Belt Company, Colmar, Pa,. has just released a booklet on **Screening Equipment for Water, Sewage, Industrial Waste.**

This profusely illustrated, 28-page book gives a description of 4 types of coarse screens and 3 types of fine screens, together with information on the selection of the proper screen to solve screening problems. Complete dimension and specification data together with tables to determine the proper size screen are also given.

Demineralizing Handbook

543

Cochrane Corporation, Philadelphia, Pa., has published a new, comprehensive 40-page book entitled, **"Handbook on Demineralizing."**

This handbook compares various methods of water treatment, as well as indicating the comparison between demineralizers and evaporators. It goes into the characteristics of the various types of available cation and anion exchange

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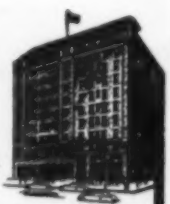
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materials and offers data on operating costs of demineralizing.

It tells when to use 2-bed, 3-bed, 4-bed, mixed on mono-bed Demineralizers. It also indicates when Decarbonators or Vacuum Deaerators are required. The bulletin is replete with typical flow diagrams, photos of installations and the chemical results obtained with demineralization.

New Process For Cleaning Clogged Trickling Filters

544

Solvent Service Inc., Painesville, Ohio, has available a report on the **First Successful Cleaning of Trickling Filter Beds in Place.**

The report gives the history and operational breakdown of how rehabilitation was obtained by the massive shrinkage and dehydrating effect of sulfuric acid and consequent charring of the organic clogging material.

Six full pages of photographs shows the complete before and after treatment conditions of the filter bed cleaned.

Liquid Level Bulletin

The Bristol Company, Waterbury, Conn., has released a new bulletin describing the complete line of **Liquid and Water Level Gauges** for indicating, recording, controlling, and telemetering.

Gauges for measuring the depth of water or other liquids, solutions, and slurries are offered in a number of different types to satisfy various requirements. These include still and moving liquids, liquids containing solids, and liquids subject to freezing. Installation methods for reservoirs, elevated tanks, and streams or canals are shown.

Engineering data on the proper choice of bulb, instrument and method of installation are presented, as well as information on telemetering of remote measurements, and automatic pump control.

Sewage Disposal Screens

545

Green Bay Foundry & Machine Works, Green Bay, Wisconsin, has available a bulletin on **Sewage Disposal Screens,** that describes the advantages and operation of "North" sewage disposal screens that primarily separates solid and liquid constituents in combination with sewage.

The bulletin shows illustrations, installations, with a partial list of municipal users, construction details, specifications, capacities, and dimension chart.

Chain Link Fence

546

Continental Steel Corp., Kokomo, Indiana, has just published a 44-page brochure and reference manual on Chain Link Fence entitled **"Planned Protection."**

The brochure contains complete specifications on light and heavy chain link fencing, illustrates and describes 10 styles of Continental fence available, shows various types of terminal and line posts, and outlines gate construction details. The important points of heavier "H" section line posts, full gauge wire, bright galvanizing after weaving, heavier post caps and arms, and other features, are also covered.

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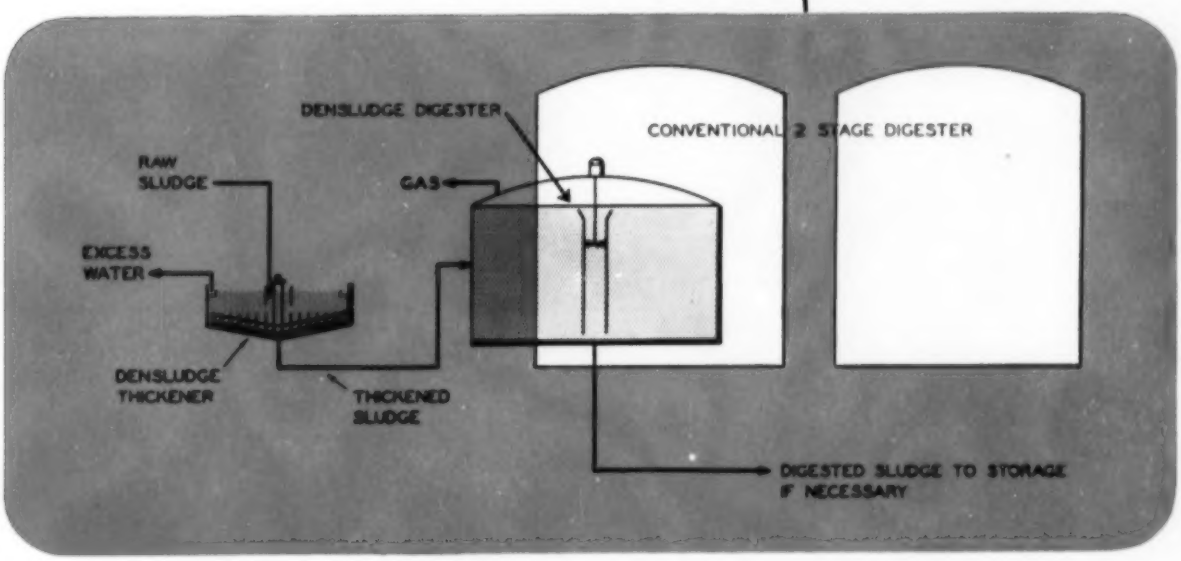

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San Jacinto Water System
12555 Clinton Drive
Houston 15, Texas
January 13, 1955

Wallace and Tiernan
1112 National City Bank Building
Dallas, Texas

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Clyde R. Harvill

Clyde R. Harvill
Superintendent
San Jacinto Water System

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